Wills Maclachlan

Proceedings of the

Twenty-First Annual Convention

of the

Canadian Electrical Association

Held at Niagara Falls, Ont.

June 21st, 22nd and 23rd,

1911

21st-24th (1911-1914)

Office of the Association

220 King Street West, Toronto

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Canadian Electrical Association

Officers 1911-1912

President:
A. A. Dion,
Ottawa Electric Company, Ottawa.

1st Vice-President:
R. F. Pack,
Toronto Electric Light Company, Toronto.

2nd Vice-President:
W. L. Adams,
Ontario Power Company, Niagara Falls, Ont.

3rd Vice-President:
W. L. Bird,
Kaministiquia Power Company, Fort William, Ont.

Secretary-Treasurer:
T. S. Young,
220 King St. West, Toronto, Ont.

Managing Committee:
J. S. Norris,
Montreal Light, Heat & Power Company, Montreal.
W. C. Hawkins,
Dominion Columbia Electric Railway Company, Hamilton, Ont.
L. V. Webber,
Toronto Electric Light Company, Toronto.
R. H. Sperling,
British Columbia Electric Railway Company, Vancouver.
A. L. Mudge.
Electric Power Company, Toronto.
C. E. A. Carr,
Quebec Railway, Light & Power Company, Quebec.
F. A. Chisholm,
St. Johns Electric Light Company, St. Johns, Que.
I. H. Wright,
North Bay Light, Heat & Power Company, North Bay, Ont.
J. H. Larmouth,
Electric Power Company, Belleville, Ont.
J. W. Purcell,
Walkerville Light & Power Company, Walkerville, Ont.
W. Phillips,
Winnipeg Electric Railway Company, Winnipeg.
D. H. McDougall,
Toronto Power Company, Toronto.
J. W. Crosby,
Halifax Electric Tramway Company, Halifax, N.S.
R. B. McDunnough,
North Shore Power Company, Three Rivers, Que.

PROCEEDINGS

The twenty-first Annual Convention of the Canadian Electrical Association was held at the Clifton House, Niagara Falls, Ontario, on June 21st, 22nd and 23rd, 1911.

The President, Mr. A. A. Dion, called the meeting to order at 10 o'clock a.m. on the morning of the 21st, and said:

This twenty-first Annual Convention of the Canadian Electrical Association is now open for business. According to the programme we are to have this morning an address from His Worship the Mayor of Niagara Falls. The Mayor will not be here for a few minutes, so I will ask the Secretary to read the Minutes of the last meeting. Before doing so I would like Mr. T. C. Martin to take a seat on the platform.

Mr. Martin, on coming forward, was greeted with applause.

The Minutes of the last meeting were then read and confirmed.

The President: I have very much pleasure now in introducing Mr. O. W. Dores, Mayor of Niagara Falls, who will address the meeting.

Mr. Dores: Mr. President, and Members of the Canadian Electrical Association: I am sure it affords me great pleasure to have the privilege of welcoming you to our city at this time. We have never had the pleasure, I believe, of having a body of men such as this in convention in our city, although we have had a great many conventions. We are perhaps not so great in numbers as many of the cities you might pick out for a convention of this kind, yet we feel we are just as great when it comes to scenic beauty. With our great river, our falls, our whirlpool, our power plants, our parks and boulevards, we think we have, and I believe you will agree with me, one of the most beautiful, if not the most beautiful, spots in the Dominion of Canada to-day. Now, I do not think that it is right that I should take up a great deal of your time in saying very much in reference to our city. Our citizens welcome you very heartily, and we hope that your stay here, whether it be long or short, will not only be profitable to you, but that you will have remembrances of it in the future that will perhaps tend to bring you back. I do not know, Mr. President, that I can say anything else at the present moment, only that the city is free to you, and I will arrange with our police force that there will be no undue advantage taken of you, providing you happen to be out a little late at night or get strayed away from the fold. Again, I say on behalf of the city of Niagara Falls, we welcome you most heartily. (Applause).

The President: Your Worship, on behalf of the Association I wish to thank you most sincerely for your presence here this morning and

for the very kind words which you have addressed to us. We knew before we came here that this would be an enjoyable meeting, because of the place in which it is held, and which has so many attractions. I wish to extend to you and your councillors an invitation to attend any of our meetings if you are interested in any matters under discussion. I can say for the members of the Canadian Electrical Association that no trouble will be made for the police. We have succeeded in leaving, wherever we have been, a fairly good record. I thank you again for your words of welcome.

The next item on the programme is the President's address. I am not going to inflict upon you a very long address.

PRESIDENT'S ADDRESS.

Members of the Canadian Electrical Association and Guests:

Gentlemen,—It gives me much pleasure to welcome you to this the 21st Annual Convention of our Association. I esteem it a great privilege to be permitted at least once a year to meet and cultivate friendly relations with the brightest men in our industry, and to work with them for the greater success of our undertakings, for the advancement and perfecting of our methods.

I would have been better pleased if our late president, Mr. Coate, had seen fit to complete his term of office and preside at this meeting. Mr. Coate, however, deemed it necessary that he should resign, and, in common with all the members of the Managing Committee, I was sincerely grieved, and accepted his resignation with great reluctance. Someone had to stop the gap for the rest of the term, and at the solicitation of my colleagues on the Managing Committee, I consented to do it, ready, as I always am, to take up my little share of the work whenever I believe I can be of some service to the Association.

During the recess the Managing Committee decided as a bold venture, to hold this year's convention at Winnipeg, hoping thereby to spread the influence and usefulness of the Association over a greater territory. Later it became apparent that it would be difficult, if not impossible, to make the venture a success under present conditions as to distribution of membership, and it was deemed better to defer until later a meeting so far west, and this beautiful and ever attractive locality was finally chosen.

Since we last met in convention at Muskoka, of which all those who attended retain the most pleasant recollections, an important event has occurred in the life of our Association, an event which I confidently believe will result in an increased measure of success, prosperity, and effectiveness for our Association. I refer to the affiliation with the National Electric Light Association which was decided upon last January. Contact and co-operation with a body so advanced and progressive in its methods, so large and influential, with access to its publications and sharers in the results of its extensive and well organized committee work on all kinds of live special subjects, cannot fail to be of the great-

est benefit to not only our individual members, but in a greater degree to the companies which they represent.

For many years the successive Managing Committees have felt the necessity of keeping our members in touch with the work between conventions by means of some periodical publication, but our pecuniary means did not permit it. I venture to hope that now arrangements will be made to secure in the N. E. L. A. monthly bulletin, which will reach all our members, a section devoted to the affairs of this Association, or, better still, that we may publish a bulletin of our own in the near future.

Arrangements have been made whereby our members, not heretofore members of the N.E.L.A., will pay for the current calendar year, not the full fee, but not more than seven-twelfths of the annual dues prescribed by the revised Constitution. This was generously agreed to by the officers of the N.E.L.A. to prevent overlapping of dues.

Gentlemen, whatever may have been our individual opinions last January, affiliation has been carried and brought into effect, and it is now the clear duty of every member to give it faithful and loyal support in the interests of all.

At the next annual convention this Association will attain its majority; let us all feel the need of using our very best efforts during the next twelve months to increase the membership, in order that we may enter the manhood stage strong and well fitted to attack the problems and difficulties of the future.

It should be considered good business for every Class "A" member company to enrol as many of its employees as possible under Class "B." An employee who joins the Association increases his value to his employer.

Your Managing Committee, with a view to building up the Association, recently acted upon a suggestion made by Mr. Frederic Nicholls last year, and appointed in every Province of this Dominion a Provincial Committee, charged with the duty of enlarging the membership, and generally to co-operate with the Managing Committee in promoting our common interests. Several cheering and enthusiastic letters were received from the gentlemen appointed, notably one from the Pacific coast, and another from the shores of the Atlantic ocean. These letters augur well for the success of this new venture.

We should take special pains to interest in our work the owners of the operating companies throughout this country, the men who decide if money shall be spent in permitting their employees to attend our meetings. Some of our members attend conventions under difficulties, or do not attend because someone above them does not realize the need of co-operation between companies for the general good of our industry.

Another suggestion of Mr. Nicholls' which, I trust, the incoming Managing Committee will carefully consider, is that some functions should be found for our past-presidents. You have frequently seen

in United States newspapers, the question asked "What shall we do with our ex-presidents?" This question forces itself upon us also. Mr. Nicholls' idea was that they should form a body, valuable, owing to the experience of its members, who could act as a sort of advisory board to the Managing Committee. I think they could be very properly entrusted with matters of public policy. When a man has reached a condition of greatest usefulness to us, let us not allow him to fall back into comparative idleness, but let us get the best that is in him for the common good.

The Meter Inspection Committee will report at this meeting what they have been able to do for the operating companies. You will see that their work has produced real and immediate benefits. There is much more that could be done in other directions by concerted action which it is impossible for the individual companies to accomplish. All operators will benefit from the actions of the Meter Committee, the sinner and the just alike. I wish the companies still outside of our ranks could be made to realize the injustice of refusing to take their share in a work from which they profit. If some companies do not get more out of this Association it is frequently their own fault. They do not use the Association when it could be of great service to them. The Secretary and the Managing Committee stand ready to furnish information and to help in difficulties, if appealed to. During my short term of office I have been addressed by several companies and was able to furnish useful infomation which I happened to have at hand.

The matter of grounding secondaries, which has been a source of so much perplexity and anxiety, seems to be settled as much as ever it will be settled. Recent pronouncements, confirming previous ones, on this subject, indicate that grounding of all secondary circuits carrying a voltage of 150 or under, should be done; even that such grounding should be made compulsory, but that grounding above that voltage may be dangerous, and should, therefore, be either forbidden or left optional.

The placing of wires underground is beginning to receive considerable attention in this country — like street pavements and artificial stone sidewalks, once fairly started they are bound to spread very rapidly, and companies would do well to shape their course accordingly. The press and the public naturally are readily seized with the idea, ignoring that in all but a very few localities the first cost and the low density of the service make such a change prohibitive at the prevailing rates for electric light and power service. While companies should try to meet public desires in every way, public bodies should be impressed with the fact that such improvements are for the benefit of the whole public, and can be, under present conditions, only a source of loss to the companies, and that, therefore, some compensation should be provided.

Uniform accounting, as a result of work done in this and other kindred Associations, is within sight. There is no reason why every company may not now adopt the systems which have been recommended by the Committees of this Association and of the N.E.L.A. (the systems being similar), but it should also be our aim to have these systems, which cannot well be improved, adopted by all municipalities and public commissions, in the public interest, in order that published results of operating light and power undertakings may be intelligently analyzed and properly understood.

The tungsten lamp has been much improved, and prices have been reduced, and no doubt will be further reduced. We may therefore expect its introduction to be more rapid than ever before. Where gas competition was keen and dangerous, this lamp was welcomed as a good weapon with which to fight cheap gas, but where no such competition exists, the minds of operators have been perturbed by the stinginess of this device in its use of current. In this rapid age it is just wonderful how rapidly we adapt ourselves to new conditions. Already our course seems to be clearly indicated. Let us not forget the trite saying that we are selling **service**, and so shape our tariffs, where we are fortunate enough to be free to do the shaping ourselves, so that no dislocation of our business will follow in the wake of the tungsten lamp.

There is no more agreeable or interesting place for an electrical meeting than this great Niagara Falls, whose scenic attractions and industrial developments excite in us at every visit feelings of wonder and admiration. Our sojourn in this town must necessarily be enjoyable and profitable.

The Entertainment Committee, under the leadership of Mr. Adams, has done nobly in preparing for our entertainment. We will all have nice things to say to them before we leave for home.

Several interesting papers have been secured for this meeting, due to the activity and skill of your Committee on Papers. Mr. Martin, who was the leading spirit, did fully up to our expectations, in a position where he had until now been untried as far as I know. These things only confirm my long settled opinion that we have in our membership a wealth of ability and resource that we have only just touched, and that can be made to yield abundantly in the future. All we need is proper unification of effort to do wonders for ourselves.

The practice prevalent in some other societies, of having important subjects presented by committees in the form of reports embodying their collective knowledge and opinions, instead of having the matter treated by one man only in a paper, has much to commend it. We might copy it to advantage, inasmuch as it amounts to a discussion of the subject which we cannot always obtain from the reading of a paper.

Your Managing Committee has been most active during the year and devoted to your interests. It is essential to our growth and progress to secure, year after year, the very best officers and committeemen available. It is also important that the Managing Committee be

thoroughly representative of the membership, geographically and every other way. I call your attention to the amended Constitution, which provides a Nominating Committee to suggest names to you for the various offices, after careful and deliberate consideration. This is for your guidance; but it will in no way rob you of the right to make other nominations when the elections take place.

I owe it to the Secretary-Treasurer to say a word in commendation of his zeal and activity. It has been a pleasure to hold office with one who responded so well to all demands made upon him, and who helped so much with valuable and timely suggestions.

I invite you to discuss freely any matters covered in this address. I will not refer it to a special committee, but will commend it to the incoming Managing Committee to consider, if they are deemed worthy of it, the suggestions which it contains.

I am duly appreciative of the honor done me by my colleagues in choosing me to complete Mr. Coates' term, and to preside at this meeting. I sincerely thank them for it and for their loyal and unselfish assistance.

I will close this rather long address, into which the personal pronoun has crept unnoticed a great many times, with a very cordial invitation to the Association to meet in convention next year at Ottawa, where I promise you a very warm welcome.

Faithfully yours,

A. A. DION, President.

The President: The next item is the report of the Secretary-Treasurer.

SECRETARY-TREASURER'S ANNUAL REPORT.

To the Members of the Canadian Electrical Association:

The work of the Association during the past year has been affected in some measure by the proposed reorganization, and my report must necessarily be brief.

The entertainment expenses of the Muskoka Convention were \$704.86, and twenty-five per cent. of the subscriptions were returned to the contributors. The Convention was well attended and very successful. Seven hundred copies of the proceedings, consisting of 310 pages, were issued, at a cost of \$416.50.

The membership on May 31st last was approximately five hundred, an increase of thirty-two as compared with the previous year. No active work was done by the Membership Committee, but now that the Association has been reorganized there is both need and opportunity for an aggressive campaign in that direction.

The amount collected in membership fees during the year was \$1,291.74. The receipts from all sources were \$1,444.86, and the expenses \$1,602.63, leaving our revenue at the close of the year \$811.43. There are adjustments to be made with the National Electric Light

Association, but I estimate that these adjustments would not have materially changed our financial position at the close of the fiscal year.

A special meeting of the Association was held in Toronto, January 20th, 1911, at which it was decided to affiliate with the National Electric Light Association. An arrangement was made with the officers of the National Electric Light Association by which the dues under the new Constitution are computed for this year from May 31st last, by which arrangement the members of the Canadian Association will not be obliged to pay dues to both Associations for the same period. One-half the fees of all the National Electric Light Association members in Canada will be credited to the Canadian Association. Under the new Constitution, a copy of which has been furnished to the members, all dues will be paid to the Secretary of the Canadian Electrical Association, and one-half of same forwarded to the National Electric Light Association.

The Constitution was amended at the January meeting so as to provide for Provincial Committees. The President therefore appointed the following:

Ontario—J. H. Larmouth, Belleville (Convener); W. L. Bird, Fort William; P. P. Barton, Niagara Falls; W. C. Hawkins, Hamilton; A. T. Hicks, Trenton; W. A. Martin, Toronto; J. W. Purcell, Walkerville; I. H. Wright, North Bay; R. J. Fleming, Toronto.

Quebec—J. S. Norris, Montreal (Convener); Julian C. Smith, Shawinigan; G. B. McNabb, Montreal; R. B. McDunnough, Three Rivers; R. M. Wilson, Montreal; Lewis Burran, Quebec.

Nova Scotia—H. C. Foss, Sydney (Convener); J. W. Crosby, Halifax; S. G. Chambers, Truro; J. A. Davis, Amherst.

New Brunswick—H. M. Hooper, St. John (Convener); J. P. Leger, Bathurst; C. G. Johnson, Woodstock.

Manitoba—W. Phillips, Winnipeg (Convener); G. A. Patterson, Brandon; J. O'Brien, Portage la Prairie.

Alberta and Saskatchewan—J. E. Prince, Calgary (Convener); J. W. Campbell, Calgary.

British Columbia—R. H. Sperling, Vancouver (Convener); L. A. Campbell, Rossland; G. R. G. Conway, Vancouver; C. Rummel, Vancouver; V. Laursen, Vancouver.

It was a matter of regret that Mr. P. S. Coate tendered his resignation as President of the Association. Mr. A. A. Dion was unanimously elected to the Presidency by the Managing Committee for the balance of the term.

Several changes occurred in the Managing Committee. Having severed his connection with the central station industry, Mr. E. A. Evans, Quebec, tendered his resignation as First Vice-President of the Association. Mr. J. S. Norris, General Manager Montreal Light, Heat & Power Company, was elected as his successor. Mr. W. C. Hawkins, General Manager of the Dominion Power & Transmission Company, Hamilton, and Mr. W. Phillips, General Manager of the Winnipeg

Electric Railway Company, were elected on the Managing Committee to fill the vacancies caused by the resignations of Messrs. J. J. Wright and R. G. Black.

The Managing Committee unanimously decided to recommend to this convention that Mr. J. J. Wright, who was the first President of the Canadian Electrical Association, be elected an Honorary Member in recognition of the valuable work which he has done, not only for the Association, but also in the development of the electrical industry. One need not be a prophet to predict that this recommendation will be received with universal satisfaction and pleasure.

Following the resolution of the last Convention, correspondence was opened with the Postmaster-General with a view to inducing the Department to issue one-cent stamps in rolls to permit of their use in stamp machines, which are important labor-saving devices to electric light and other companies using large quantities of stamps. The following is an extract from their reply, dated September 20th, 1910: "The Department is giving this subject careful attention, but as there are certain difficulties in the way — difficulties, however, which it hopes shortly to overcome — it is not practicable at present to give you any more definite information than to state that when the Department is prepared to issue stamps in the way indicated the public will be duly advised of the fact. It may be added that in order to recoup itself for the extra cost of producing stamps in rolls as compared with the ordinary method, it will be necessary for the Department to charge, as does the United States Post Office, to whose practise in this connection you allude, so much per coil or roll in excess of the face value of the stamps; also that for the protection alike of the consumer and of the postal revenue, the Department will require that the preparation of all stamps for the purposes mentioned in your letter shall be effected only by the person or persons authorized by it to do such work; and to that end will take the necessary legal steps."

On May 17th the Department was again reminded of the matter, when they replied that it was still under consideration, having been delayed by circumstances beyond the control of the Department, but that it was hoped that an announcement on the subject would soon be made.

On the question of franked window envelopes, the Department replied as follows: "Touching your further suggestion that the Government issue a franked window envelope with the one-cent stamp embossed thereon, the Department regrets that it is not possible to meet your wishes, because the contract under which stamped envelopes are manufactured and supplied has no provision whereby special lots of envelopes such as that implied in your enquiry could be furnished, and because, moreover, the embossing of any special kind of envelope might leave the Department open to the criticism that in doing so it was interfering with private enterprise in the stationery and printing business."

I append my financial statement, duly audited.

FINANCIAL STATEMENT.

Cash in hand, June 1, 1910		$ .61
Cash in Bank, June 1, 1910		968.59
Receipts.		
Membership Fees	$1,291.74	
Surplus from Convention Finance Committee	91.59	
Interest	31.05	
Transfer from Legislation account	19.73	
Refund from Eastern Canadian Passenger Asso'n	10.75	
	$1,444.86	1,444.86
		$2,414.06
Expenditures.		
Publication of proceedings, 1910 Convention	$ 416.50	
Printing advance copies of papers and reports of Committees	110.75	
Stenographic report special Convention, January,		
Badges	61.60	
Numbered buttons	19.25	
Clerical assistance during Convention and expenses	25.00	
Meter Committee, printing	6.40	
Engraving for illustrations	38.72	
Statistics Committee, printing	69.75	
Statistics Committee, stenographic assistance	7.20	
Statistics Committee, editing and compiling central station data	40.00	
Stenographic report special Convention, January 1911	35.00	
Grant to Secretary-Treasurer	300.00	
Bond for Secretary-Treasurer	5.00	
Expenses Local Committee	12.60	
Expenses Managing Committee	24.25	
Stenographic assistance	14.30	
Postage	146.00	
General printing	86.65	
Convention printing, program, etc	65.25	
Stationary and supplies	27.75	
Telegrams	4.06	
Express	4.20	
Exchange	11.40	
Refund of dues overpaid	5.00	
Gratuities	1.00	
	$1,602.63	$1,602.63

Cash in hand, June 1, 1911	19.08
Cash in Bank, June 1, 1911	792.35
	$2,414.06

Respectfully submitted,

T. S. YOUNG, Secretary-Treasurer.

AUDITORS' REPORT.

To the President and Members of the Canadian Electrical Association:

We, the undersigned, having examined the vouchers and audited the books of the Canadian Electrical Association, from May 31st, 1910, to May 31st, 1911, certify that we have found them correct.

R. G. Black,
J. W. Purcell,
Auditors.

Toronto, June 15th, 1911.

It was moved by Mr. P. H. Kemble, and seconded by Mr. F. A. Chisholm, that the report of the Secretary-Treasurer be adopted.

The President put the motion, which, on a vote being taken, was declared carried.

The President: I would like Mr. J. J. Wright to come forward.

(Mr. Wright takes a seat on the platform.)

The President: Mr. Wright, in the report of the Secretary-Treasurer it is said that the Managing Committee has recommended that you should be elected an honorary member of this Association, and that report has been adopted. It is now my privilege to convey to you this act of the Association. There is nothing which could give me more pleasure than this announcement. As you know, I have been associated with you in the management of this Association for a great many years, and during that time we have formed a friendship which I trust will last as long as we live. Both for myself and on behalf of the Association I wish to express the great pleasure which we feel in being able to tender to you this very feeble recognition of your eminent services to the Association.

Mr. Wright: It is needless for me to express the deep appreciation I feel for this unexpected honor which the Association has seen fit to bestow upon me, and I wish to tender to the Managing Committee and the members my very sincere thanks. (Applause.)

Letters regretting their inability to be present were read from Mr. W. W. Freeman, past president of the National Electric Light Association; Prof. D. C. Jackson, president of the American Institute of Electrical Engineers; S. E. Doane, chief engineer National Electric Lamp Association, and others; also a cablegram from Mr. Leonard Andrews, of London, Eng.: "Best wishes for a successful convention."

The Secretary then read the following correspondence:

London, W.C., Eng., November 26th, 1910.

The Secretary,
The Canadian Electrical Association,
Toronto, Canada.

Dear Sir:—

I laid before the Council at their last meeting your letter of July 24th, conveying the invitation from the Canadian Electrical Association to members of this Institution to attend their annual convention next June and to visit electrical and engineering works.

The Council desire me to express their cordial thanks for the invitation, which is highly appreciated, but they regret exceedingly that in view of the Coronation ceremonies next June it will be impossible to arrange for an organized visit of the members, or even for a delegation.

Yours faithfully,
P. F. ROWELL,
Secretary The Institution of Electrical Engineers.

Berlin, Canada, May 30th, 1911.

T. S. Young, Esq.,
Secretary Canadian Electrical Association,
Nicholls Building, Toronto, Ont.

Dear Sir:—

Provision is made by the Ontario Statutes for expropriating for the purpose of right of way of transmission lines for electrical purposes, but no provision is made for expropriating for the purpose of storage of waters by damming to increase the head of the waterfall, or to more uniformly regulate the flow for power purposes. It may be exceedingly necessary in order to get the benefit of a waterfall to conduct the water either above the fall or below it in some other way than in the natural channel. The usefulness of an important waterfall may be lost through property owners who might be affected refusing to allow any damming for storage purposes along the sources of supply, also the land adjacent to the waterfall may be such that development may be impossible or impracticable without damming, or without creating an artificial channel either above or below the falls.

Besides the above useful purposes by damming, I think the public would receive great benefits as and incidental to the increase in the bodies of water used for storage purposes. I refer to the prevention of forest devastation by fire and also to damages from spring floods and freshets. Streams used for storage purposes which become almost dry during the middle of summer would provide fire guards through large timber districts if full of water, and in addition to this, low lands joining such streams would not be liable to be over-run by fires, and so the course of forest fires would be broken.

I think for public reasons, as well as private, legislation as suggested would be exceedingly beneficial, and I take the liberty of bringing this matter to the atention of the Association, as I consider the Associa-

tion specially fitted to judge of the importance of it, and I fully believe its recommendation, to the Legislature of this Province, would result in an Act of the Legislature to meet these wants.

Yours very truly,

D. B. DETWEILER,

President Algoma Power Company.

Mr. R. F. Pack: I think, Mr. President, that the letter from Mr. Detweiler should receive some consideration, either by referring the matter to a committee, or passing it on to the incoming Managing Committee for action. It deals with matters of very great importance and is worthy of more consideration than we can give it here.

The President: I agree with Mr. Pack that this is a letter which opens up a subject of very great importance at the present time, and that it should not be passed over by merely inserting it in the proceedings. Possibly a special committee might give it more careful attention. The personnel of such a committee would be named by the President later on.

It was moved by Mr. Pack, seconded by Mr. Chisholm, that a special committee be appointed, and on a vote being taken the President declared the motion carried.

The President: The next item is ''General Business.'' This gives the members an opportunity to bring up any subject they may wish to discuss. If there is nothing at the moment we will pass on to the reading of the papers. The first paper is by Mr. E. Little, of Fort William, on ''Operating Safeguards.'' As Mr. Little is not present, and it is necessary to proceed according to schedule, I will ask Mr. Pack to read the paper.

OPERATING SAFEGUARDS

By E. Little

The object of this paper is to pass in review a few of the necessary safeguards for up-to-date operating, emphasizing those points which have particularly come under the writer's notice.

The average operating man has no say in the matter of choosing what sort of apparatus he will operate with. He must step in and do the work, no matter what device he is called on to work with. He is fortunate if he has had the opportunity of working with the constructing engineers of the plant which he will operate, thus getting the benefit of their experience first hand.

The subject of "safeguards" is a large one, and time will not permit the writer to cover the matter as fully as he could wish.

Two general headings may be considered:

1. Safeguards insuring the continuity of service.
2. Safeguarding life and property.

Under the first heading, first mention should undoubtedly be made of the importance of governors and voltage regulators. Most manufacturers of such apparatus issue instruction books which are well worth studying. Where both are installed it must not be overlooked that they must work in perfect unison; equal care and attention must be given to each. A voltage regulator will not work at its best if the governor is too sluggish, or has a tendency to pump. Conversely, a good governor cannot properly take care of the load if the regulator is neglected.

Oil Switches and Circuit Breakers.

These have come into such general use that one wonders at times how we ever got along without them.

Periodical inspection should be carried out from at least once a month to twice a year, depending on usage, type of switch and service; and, if possible, always after opening under short circuits. The two most common forms of trouble, however, which have been noted are the leakage of oil and the working loose of the wooden rods which carry the moveable contacts; the latter trouble being liable to prove a serious matter if neglected.

Mention should here be made of a type of switch used by some European engineers for high tension switching of transformers, and one which might well be more extensively used in this country. The switch referred to has an intermediate set of contacts connected to a suitable resistance, over which the moving contacts pass, and

is so arranged that the transformers are not subjected to the sudden strain of the full line potential, either when closing or opening the circuit.

As most operating men are aware, in certain types of transformers, of 10,000 volts and upwards, there is danger of a discharge when connecting them to the full line potential with the ordinary single contact switch. Objections might be raised against the more complicated construction of the multi-contact switch, but it should nevertheless prove a real operating safeguard.

Protective Relays.

A fair sized volume might easily be written of the many types of relays and their merits. From the days of open fuses and manual switches to the present elaborate development of relays and remote controlled switches, is a far cry, and the switchboard operator of the present day no longer finds it necessary to put on a hat and turn up his coat collar to protect his neck from a shower of melted fuse wire from the row of open fuses at the top of the switchboard.

Each power plant has its own peculiar local conditions, and such protective devices as relays must be so placed as to meet those conditions. Where several are used between the generator and a given point in the distribution, great care must be taken to decrease the settings step by step outwards from the generator.

For transmission lines and feeders in multiple, the overload and reverse current relay is coming into extensive use. Of these, probably the most notable is that which is built on the principle of a wattmeter. It is claimed for these that when operating on multiple feeders, they will effectually cut out the one on which a short circuit occurs, without disturbing the rest of the system to any appreciable extent.

This instrument is best suited to large systems, where the requirements call for accuracy in operation. They are superior to the solenoid type, although the latter being of more rugged construction, are better adapted to unimportant feeders in out of the way places.

Lightning Arresters.

In certain localities arresters are a very necessary safeguard. For several years the writer has been operating in a district which seems to get its full share of lightning from May to September in each year. The system has a 25,000 volt, 3 phase, 60 cycle grounded neutral transmission line 18 miles in length, with 3 sub-stations stepping down to a 2,400 volt delta distribution.

Multigap arresters were included in the original installation, both on the high and low tension sides. Soon after commencing to operate, horn gap arresters with a water resistance contained in tile

piping, were installed at each end of the transmission lines. Considerable difficulty was found in maintaining the resistance at a constant value, apparently owing to changes in temperature and humidity. Heavy discharges sometimes took place for no apparent reason, and on one occasion a lightning discharge completely destroyed the resistance container of one phase. The company then decided to instal electrolytic arresters of the aluminum cell type. These have given excellent satisfaction, not only in periods of storms, but in relieving the lines of static stress under less severe surges, from whatever cause.

On the low tension distribution, the practice of this company is to use both the straight multi-gap and Garton types of arresters; the former at line and cable terminals; the latter at each important bank of transformers, and at intervals on the overhead lines not more than half a mile apart.

On one occasion, three different sets of arresters, on different circuits, discharged simultaneously, causing a heavy short circuit which did not clear itself. As a result of this experience, a trial is being made of placing a heavy fuse in the ground connection of each set of arresters.

It is realized that more complicated problems arise in the protection from lightning of a distribution system than is the case with transmission. Much has yet to be learnt, and that by actual experience, of the proper methods of disposing of arresters on a network where aerial and underground feeders are interconnected. This much can be said, however, that frequent and careful inspection must be made of all arresters, of whatever type. They are the safety valves of the system, and from the very nature of their construction are likely to cause trouble unless kept in perfect adjustment.

Installation and Care of Aluminum Cell Arresters.

Before leaving the subject of arresters, a few remarks on the care of those of the aluminum cell type will not be out of place. In the first place, great care is needed in their erection. It pays to follow to the letter the instructions issued with this apparatus by the makers. Every part should be made scrupulously clean, especially the stacks of cones, which should be blown out with compressed air, if possible. The electrolyte must be absolutely free from impurities, and the same quantity must be used in each cone throughout the stack. Before placing the stacks of cones in the oil tanks it is well to charge the cells, preferably one or two at a time, depending on the voltage obtainable. The filling and charging in this manner is a somewhat irksome task, but well repays for the patience and time spent. The oil should be well filtered, and poured into the tanks in such a manner as not to disturb the electrolyte in the cones.

The setting of the horn gaps is a matter requiring careful study of local conditions. In the instruction books a table of maximum and minumum settings is given. The practice in first setting up is to give the gaps the medium value, then watch the action of the arrester during disturbances and adjust either way, using caution in approaching the minimum setting.

It is extremely important that the ground connections be of the best and of ample capacity. In stations where the ground plate is used, it is considered good practice to supplement this by the driving of iron pipes at intervals about the station and bonding them together and with the existing ground.

Lastly, the regular charging of the cells is all important. Once in the 24 hours is generally considered sufficient, but this company has found it better to charge every 12 hours, thus keeping the cells in a more uniform condition. This, however, is a matter which must be governed by the local conditions under which the arresters are operating.

Ground Detectors.

Every distributing station, operating with delta connection, should be provided with ground detectors. These should be so connected as to indicate a ground on any part of the distribution system, and at the same time be provided with means for locating which of a number of circuits the trouble is on.

In the main distributing station of this company, the equipment is in duplicate throughout. In the event of a circuit becoming grounded, or having some known defect, it is isolated on a separate set of bus-bars and bank of transformers without interruption of service, until remedied.

Many stations are not provided with ground detectors. In some banks of lamps are used, and periodical tests made, but there is nothing like having an instrument right before the operator's eye.

An incident recently came under the writer's notice which clearly shows the advisability of using such instruments. One of the municipalities connected to our system has lately installed and put into service a sub-station, receiving at 22,000 volts and distributing at 2,200 volts for power and light. About the same time a wireless telegraph station was also built at a short distance from the sub-station. The municipality had been previously getting power from a different source, and a number of changes were being made to conform to the new system of distribution. There were no ground detectors on the system. A short while after the new installation had been in operation, the operator of the wireless station began complaining of disturbances on his receiving aerial, which finally became so bad that they were put completely out of commission. The wireless company approached the power company, claiming there

must be a discharge somewhere on the power system, presumably on the 22,000 volt transmission, and requesting that tests be made to determine the source of the trouble. The power company willingly complied, thinking it would be a decided advantage to cooperate with a concern that could detect the trouble, however slight, by simply sitting still and listening for it. Tests were conducted, lines were changed, etc., but without result. This cleared the power company. The wireless people then turned their attention to the local distribution system, but could not, for various reasons, seem to make any headway. Finally, after more than a week, the trouble was cleared in a sudden and somewhat startling manner. One night one of the principal sections of the city was suddenly thrown into darkness, the switches at the sub-station tripping under a short circuit. A pole transformer had burnt out and a 2,200 volt wire had fallen to ground; proving conclusively that the wireless station had been acting in the capacity of a ground detector.

Had such an instrument been under the observation of the sub-station operator, there would certainly have been a great saving of time, trouble and damage.

Malicious Interference with Lines

In many localities where transmission lines cross sparsely settled districts, this sort of trouble is frequently met with, shooting at insulators and throwing string-balls, sticks, etc., on to the wires being the most common forms of mischief. With systems of 20,000 volts and upwards, this invariably causes a partial or complete shutdown. The offering of rewards for information leading to the conviction of offenders, is a doubtful remedy, but every other effort should be made to track them down, secure a conviction and have publicity given to the proceedings in the local press. The power company's solicitor may, however, in the case of a first offence, recommend to the presiding magistrate that sentence be suspended. This will create a good impression, and give the public an opportunity to note that the power company is not vindictive. The fact of a conviction having been secured will have a salutary effect on other would-be offenders.

Safeguarding Life and Property.

Modern electrical installations appear at first sight to be so near perfection that one is almost led to ask "What better protection could you have?" Nevertheless, there are enough fatal accidents happening from electrical causes, compelling us to keep in mind the necessity for putting forth every effort to increase the safeguards.

Accidents to Operators and Linemen.

Amongst station operators and linemen, it would appear that by far the larger percentage of accidents are due to absentmindedness. This is akin to carelessness, but there is a difference; the absentminded man may also be a careful one.

In such occupations, men must be drilled into concentrating their minds on the work in hand, and it is the station superintendent or line foreman who must do this.

Precautions.

The use of rubber gloves should be insisted on where there is danger. In stations, switch hooks must be kept in a dry place, preferably near the switches for which they are used. On concrete floors wooden racks should be provided for use in high tension transfers. If the racks are properly made of kiln-dried lumber, pegged together (not nailed or screwed) and varnished, they should be safer than the average rubber mat.

Pieces of rubber matting, however, are very useful around low tension work, not only for standing on, but for hanging over live work for the protection of men who may have to make repairs or changes in close quarters.

Responsibility of Operator.

Linemen on repairs, etc., in addition to guarding themselves from danger in their immediate surroundings, frequently have to depend on the switchboard operator. It is here that one man has often the opportunity of causing disaster. Circuit switches opened for linemen should be immediately plugged with some device bearing a danger label. A large circuit map should be in evidence with stickers in the form of little red flags, to be placed at danger points on the map by the operator himself.

Danger Notices and Barriers.

At points in the station where the greatest danger exists, such as high tension bus-bar compartments, notices should be prominently posted, and if these places are not entirely closed with doors, a wire gate, or even a light chain, should be used. The moral effect of having to remove something in the form of a barrier, however light or simple, when approaching the danger point, assists in putting a man on his guard.

Admission of the Public.

At some stations the public are strictly prohibited from entering; iron gratings being sometimes used at the doorways, which permit of peeping only. In some respects this is a good rule, but

is apt to heighten the fears of the timid, in the uses of electricity.

In stations where the public is admitted, or where the office of the manager or superintendent is in the building, thus causing traffic, precautions must be observed. Umbrellas and walking canes should be left at the entrance; dogs must on no account be allowed to enter; nor children, unless accompanied by a guardian who must be warned to keep them absolutely under control.

In such places, and especially if the public of the locality is composed of different nationalities, the danger signs should bear a large print of a skull and crossbones. Such notices are a trifle gruesome, but effective, and constitute a warning in language which is universal.

The average visitor has generally a wholesome respect of electricity, but occasionally the operator will have to deal with one who has a foolish and uncontrollable curiosity. Such a one is very likely to get the operator and himself into serious trouble unless very carefully watched.

Operating Bulletins.

Where operating troubles have occurred, it is important that each incident be carefully investigated and reported in writing, so that the circumstances will be impressed on the operator's mind, and to permit of correction and the pointing out of better methods of handling similar conditions in the future.

These reports and bulletins should be kept on fyle for the future reference of other or new operators.

Where an operator carefully studies all the conditions of operation, and his course of procedure in the event of emergencies, he has gone a long way towards eliminating blunders, which might have serious results to the service, or possible loss of life, with consequent loss of reputation of himself and his company.

It is recognized that all the bulletins and personal instructions are of little avail, unless the operator has trained himself for coolness and concentration of mind, so that he may be better enabled to handle any emergency with confidence.

This brings into prominence the importance of the health of the operator, with its implied responsibility on both the company and the individual, each to each.

Emergency Tools and Medical Equipment.

A cabinet of emergency tools and another of medical supplies should be carefully maintained by each department.

Drill for instruction in first aid in cases of electric shocks should be given, and cards bearing the same instructions kept handy for reference. The address and phone number of the company's doctor might be attached to these cards.

Trouble on Pole Lines.

It is advisable to encourage the public to notify the power company of any trouble noticed, such as a fallen or hanging wire, a smoking transformer or crossed wires flashing. Names and addresses of persons giving information should be ascertained, and the power company will lose nothing by addressing a short letter of thanks to informants.

Danger from Grounds.

It is perhaps not generally realized that danger to life is greatly increased by the existence of grounds on a 2,200 volt system, especially where lighting is furnished from numbers of small transformers, each a potential point of danger and weakness. The danger is being largely reduced by the grounding of secondaries on modern systems. There is no law, however, compelling this, and most of the smaller systems have failed to make the change as yet.

Even with this safeguard, the danger to linemen would still exist, as while ordinarily a lineman might get a slight shock, or warning, he would in the event of a ground existing, receive a shock which would be more liable to prove fatal.

The danger to property, especially in large and extended cable systems, has been demonstrated, as in the case of the destructive surge and resulting damage to a prominent New York company a few years ago; see Vol. 24, Proceedings of A.I.E.E., 1905, "High power surges in electric distribution systems of great magnitude," by Dr. Steinmetz.

Unnecessary Opening of Circuits.

The first instinct in case of trouble or danger, on the part of the public, and even some of the less experienced linemen, is to call for a circuit to be opened. This is the easiest apparent solution. To the switchboard operator, however, with the knowledge of perhaps hundreds of horsepower depending on continuous service, the opening of a circuit is a serious matter, and he must impress on the outside man the necessity of using every other effort to clear the trouble, having due regard to life and property.

A circuit once made dead from the station is liable to involve serious delay and risk before it can be made alive again.

Operating Without Communication.

The various station operators and power consumers of a large system should be instructed as to procedure in emergencies that might occur at a time when the phone or bell signal service may also be out of commission. A thorough understanding of what to do under these circumstances will add greatly to the efficiency of the service.

General Remarks.

All power consumers, school principals and teachers, doctors and policemen should receive from the power company a circular letter, requesting in courteous language their co-operation in safeguarding life and the electrical service.

We are all striving to attain one end, viz., "perfect service," and the more one investigates, the more one realizes the necessity for the co-operation of all, be they company or individual.

In conclusion, attention is called to the item, "Teaching the Young to Respect Electricity" in the editorial column of the May, 1911, number of the Electrical World, which touches the very root of the matter of safeguarding the public, and incidentally, the continuity of the service.

The writer is thoroughly in accord with the views therein expressed, and firmly believes that future education on the uses and abuses of electricity must eventually begin in the public schools.

The writer desires to acknowledge the assistance of Mr. W. L. Bird in collaborating and for use of operating bulletins of the Kaministiquia Power Company, Limited.

DISCUSSION.

The President: The subject of this paper is one of the greatest importance, not only to operating companies, but also to manufacturers. While the subject is not new, it is still an open one, as there is diversity of opinion among engineers as to the best safeguards. There is therefore room for discussion.

Mr. P. H. Kemble: There is one paragraph on page 10 which appeals to me rather from the commercial side of the proposition. That is in regard to unnecessary opening of circuits. The commercial department of a company usually has troubles of its own in securing and keeping customers and smoothing out the complaints which naturally arise outside of operating causes, such as rates, or billing errors, or service exceeding the cost which was given, or something of that kind. All those subjects of complaint are very easy matters of adjustment, compared with complaints which arise from discontinuity of service. I cannot speak too strongly on the necessity of the operating department using every possible effort to stop trouble without causing an interruption on the lines.

Mr. Pack: Mr. Chairman, early in the paper it is suggested that putting wire gates in front of a station to keep the public out, and allowing them only to peep in, is liable to frighten the public and lead them to believe that the use of electricity is attended with a considerable amount of danger, and then on the last page, in the general remarks, it is suggsted that all power consumers, school teachers, doctors and policemen should receive a circular letter practically warning them of the possible dangers attending the use of electricity. Now, that doesn't seem

to me consistent. I do not think for one minute that the proper use of electricity is attended with any serious danger to the public, and if such circulars are sent out they should be written very carefully and most tactfully.

Mr. I. H. Wright: Speaking along the line referred to by Mr. Pack, I recognize in this particular a danger to the business end by educating the young to the dangers of electricity by the method suggested in Mr. Little's paper, which conflicts somewhat with the manner of dealing with the danger by the introduction of wire gates as suggested later in his paper.

Mr. Glenn Marston: Mr. Chairman, it seems to me that there is no possibility of our denying that the improper use or the improper interference with electrical service is dangerous. On the other hand, nobody can deny that the proper use of electricity is absolutely without danger, and it seems to me that the important thing to impress upon the public is, if they make use of electric current under the direction of the operating company that there will be no danger, but that the really important thing to do is to give proper regard to all the safeguards that are provided. The really important thing to be impressed upon the public is that they have to be careful. We have to be careful in conducting our business or we would kill our men off as fast as we could hire them, and if the public exercised the same care that is exercised by the company there is absolutely little danger, but at the same time there is danger that must be looked out for.

The President: As regards the instructions to be given to linemen in connection with the danger to life, and how to take care of themselves, and in case of a man receiving a shock, how to take care of him in order to bring him back to consciousness, I believe that in addition to the printed instructions accompanied by pictures to show very clearly how the methods are to be applied—in addition to that, I thoroughly believe a practical demonstration to be given by a physician or someone competent to carry it out in the presence of the men, is very important. We have tried that and we have found it conveyed more real information than any other method. A thing must be done well or it might as well not be done at all, and this practical demonstration teaches the line men by illustrating and explaining each motion, so that they can work afterwards in an intelligent manner. I would also call your attention to what is known as the prone method as distinct from the other. In the prone method, as many of you know, the patient is laid face down on his stomach, and his head is turned to one side so that the mouth and tongue may be free, and then pressure is applied to the back at the lower ribs to squeeze out the air from the chest. You do this by throwing your whole weight on him and then you suddenly release him from your weight, and the ribs rebound and the chest is filled up. Now, I don't know, but I am told that this method is more likely to be successful in the hands of inexperienced persons than any other, as it is exceedingly simple. One point which struck me in reading about it as

very important is that the treatment should be applied at once. Every minute and every second counts. In fact, one writer states that you should not even take time to loosen the waist belt or collar, but simply turn the patient on his stomach at once and immediately begin operations.

Mr. Pack: The Toronto Company not long since had lectures given to its employees by a doctor on "First Aid to the Injured," having special reference to resuscitation from electric shock. I think it would be a good plan for member companies of this Association to do likewise. Even the smallest companies in the smallest towns can get a doctor at some convenient time to give a lecture or two which might prove invaluable.

Mr. Kemble: Isn't that an opportunity for the Association to step in and get out a little illustrated bulletin with photographs showing the different methods, and these could be distributed to the smaller companies for a small fee? It seems to me that is a thing which could be handled through the Association very effectively.

Mr. Martin: This gives me the opportunity to state that during the past year the N. E. L. A. has directed its attention to this subject of resuscitation. Realizing, as you have brought out, Mr. President, that more than one method has its vogue, and that there is not an agreement upon what is best in practice, the N. E. L. A. has invited into its councils several of the national bodies in the United States, and has had the co-operation of the Army and Navy Departments, as well as the American Medical Association, our foremost body of that character. We are now organizing a commission which will consist entirely of medical men, and we are proposing to subsidize that body to the extent of meeting all its valid expenses; and we are hoping during the coming year to have a report made which will be of value and assistance to every member company, and to the electrical industry at large. We are proposing to invite into our councils and ask them for their assistance, sister societies on the other side of the water, such as the French, German and English bodies, so that our methods may be in agreement and in accord with what they also would recommend. Following out the excellent suggestion of Mr. Kemble, we hope to present to our sister society, the Canadian Electrical Association, what may be considered the best and most up-to-date and fully recognized methods of resuscitation. In our own country, the U. S. Bureau of Standards, with the consent of the Government, has undertaken the free distribution of this literature, and I think you will have no difficulty at all in securing the co-operation of your own Government in this work. The N. E. L. A. is very proud to have been permitted to take the leadership in this humanitarian work.

Mr. John Murphy: I would like to point out that at least two branches of the Dominion Government service have already taken action in connection with the subject of spreading information in regard to the possibility of resuscitating persons who have been electrically

shocked into insensibility. Nearly five years ago the Department of Railways and Canals procured several hundred copies of the illustrated bulletin—which was published by the Electrical World—and had them posted up in conspicuous places at every point on the Canadian Government railways and on the canals where electrical energy was delivered from transformers or any devices connected with high tension circuits. About two years ago the Board of Railway Commissioners issued an order directing every railway under its jurisdiction to have these same bulletins, or similar ones, posted at every point where employees were at all likely to come into contact with wires which might be dangerous. In this manner a wide circle of non-technical people have become acquainted with the possibilities of resuscitation by means of artificial respiration.

The President: It remains for me to thank Mr. Little for his kindness in making this contribution.

The next paper, and the last one to be read this morning, is on the "Advantages of Publicity to the Central Station Industry," by Mr. Glenn Marston, of Hamilton.

THE ADVANTAGES OF PUBLICITY TO THE CENTRAL STATION INDUSTRY

By Glenn Marston

So much advice has been given regarding publicity, and so little of it taken, at the meetings of the various affiliated sections of the National Electric Light Asociation, that I do not intend to do more than touch upon a few of the successful plans which have actually been put into practice.

Publicity means nothing more than getting before the people—preferably in a favorable light. Many electric company managers feel there is ample chance for unfavorable publicity, but they do not appreciate the countless opportunities which arise every day for favorable publicity. Since the managers themselves do not realize these opportunities, now can it be expected that the outsider, who has no direct interest in the company, will discover them?

Newspaper publicity falls broadly into two classes—paid advertising, and free reading notices. Paid advertising or ''display,'' should be used to call the people's attention to features of the company's business which are not essentially news. Free reading space is almost always gladly given when something of news value occurs concerning the company. Perhaps I can best explain the distinction by a recent incident in Hamilton.

The company there decided to run a series of advertisements showing the countless uses to which electric power is put in Hamilton. The purpose was to induce other manufacturers to come to Hamilton and use Cataract power—and, incidentally, to show the people of Hamilton what part the Cataract Company has played in the last ten years of the city's growth. These advertisements, each describing a certain industry, were written from the company's point of view, of course, and hence, while news in a sense, they were properly published as display advertisements.

On the other hand, the fact that the company was publishing these advertisements and trying to secure new industries for Hamilton was real news; and of vital interest to every resident of the city. Therefore every newspaper in the city had a news article calling flattering attention to the efforts of the company to get new industries. New industries are of vital interest to the whole community. Increased power consumption is of interest only to the company. That explains, as clearly as is possible, the difference between free and paid advertising.

I am unalterably opposed to payment for-reading space in newspapers. My position in this matter is that any news item worth print-

ing as news will be taken by the editor strictly on its merits as news, and if it cannot command enough readers to make it worth printing as news it certainly cannot be worth paying for. It is a matter of considerable pride with me that I have never authorized payment for a line of reading matter in all the publicity work I have done, yet I have been most generously treated by the editors.

There are innumerable happenings of news value in connection with every central station. The closing of a power contract, with the customer's reason for adopting electricity, makes good reading for the public and helps the company. A few hunches to your editor on the romantic features of electricity will give them opportunity for columns of material. I think of the following in my own past experience:

How much coal it takes to keep the people cool in summer.

How far an electric fan would roll in a day.

How electric fans prevent typhoid.

How the life of the whole city is dependent on their tiny wires.

How electricity has reduced the use of child labor.

How electricity has done more to better the workingman than all the unionism the world has ever seen.

The effect of window lighting on a city's growth.

The police value of light.

Odd uses of motors and electric heating.

I could go on indefinitely with such subjects, but these will give you an idea of the infinite variety of topics which can be brought up and dealt with by an editor who knows little and cares less of the technical side of the lighting business. Some of the reading matter which I have had published verges dangerously on the commercial, but I have always made these articles appear to be of greater interest to the public than to us. That is the best way of getting into the news columns.

Because I have dealt with free reading space first, do not think I hold it more important than the paid advertisement. In the first place, advertising is the backbone of the newspaper, and the proprietor has a right to expect you to advertise just as much as any other firm in town which has something to sell to the public.

Making electric current has long ceased to be the sole duty of the central station man. He must now sell it, and after he has sold it, see that it is properly delivered. He is subject to criticism in each of these performances. If I buy a novel, and find it is no good, I do not blame the bookseller—I blame myself. I do not know whether other merchants are criticized as much as the central station men. I hope not. When a customer's lamp burns out, he is likely to blame the company, even if he bought the lamp from some dealer. It is the fashion to criticize corporations and we must change that fashion.

As each new season comes around we see new changes in styles of dress. Most prominent among the recent ones is the hobble skirt. My opinion of women's intelligence is too high to believe that she volun-

tarily adopted the hobble skirt. Fashion-makers decreed the hobble skirt; and how did they go about getting it worn? They made people talk about it. They had models wear it at the races and wherever else the public was gathered. They got window space and displayed it —and each of these schemes was turned to news.

It is just as easy for us to abolish the fashions of criticizing corporations as it was for the fashion makers to abolish the bustle, the balloon sleeve, and the wasp waist. We can take a leaf from their book and apply it to our own business.

My own experience has led me to have unbounded faith in the use of the display advertising columns of newspapers in educating the public. The company's business story is best told over the company's own signature. It takes away all oportunity for your opponents to claim you are "tainting" the news columns. The answer to any such accusation is obvious: "If we have anything to say, we use our advertising space. There is no need of our 'tainting' the news columns. If any paper prints anything about us in its news columns, it is because it is news, not because of any desire on our part to influence the news. If we cannot influence favorable opinion by the arguments set forth in our advertising space, it would be folly for us to attempt a less direct, and therefore less effective method."

In commercial matters the value of publicity is measured by its ability to create gross earnings; yet it is of great importance in directing the demand for electricity along lines which will give the company an opportunity to increase its net earnings. There are many classes of power business which, though bringing a low rate, give a greater percentage of net profit than the high-rate lighting business. The only lighting business I advertise is long-hour commercial lighting—window, store, and sign lighting.

This class of lighting is not only more profitable than residence lighting, but every down-town installation is a live advertisement of electric light right where everybody can see it. If a merchant is satisfied with his store lighting, it is safe to assume he will put it into his house.

Publicity can be made an effective agent in levelling the load curve. If the power load is low, power should be advertised for. If a station has an inverted curve publicity can be effectively used in building up the night load. I have sometimes devoted several days advertising straight at one particular customer. Its general effect has been quite as valuable as if I had nobody in particular in mind; yet, since the man I was aiming at did not know he was specially under fire, the arguments advanced in the advertising appealed to him as applying in his case as one out of many.

Advertising should tell a story. "Flat irons—$3.00" is not enough to put in an advertisement. The merits of electric ironing are not sufficiently well known to warrant the assumption that price alone will attract purchasers. A paragraph or two on the unique features of

electric ironing will attract more atention than low price. When convenience is a consideration, price is secondary. People should be convinced that the convenience of electricity makes it cheap at any price.

I could go on all day and give you points on publicity which you would probably forget to-morrow. An advertising man is trained not to tell too much at once for fear he will weary his readers to forgetfulness. The science of publicity has not reached the point yet where rules of conduct can apply. It is an exception to the fundamental law of physics that similar phenomena take place under similar conditions. The only way to conduct successful publicity is to put it into the hands of experienced men, just as you do your engineering problems. I hope your interest in publicity will not cease with the applause with which I suppose you will greet the close of this paper. Hand-clapping will not advertise your business, but publicity will.

DISCUSSION.

The President: Here is a very bright paper on a subject which is of very vital interest indeed to all Central Stations.

I have at meetings similar to this outside of this country heard it stated by managers of some very large companies that newspaper advertising did not pay. They rather pinned their faith on monthly bulletins issued from the company's office and other means of reaching the public. On the other hand, I know some of the largest companies that use newspaper space quite liberally, so that here is another subject on which there is room for discussion.

Mr. T. C. Martin: I am very glad indeed to have heard this paper from my friend Mr. Marston, expressed in his usual epigrammatic way. In respect to newspaper publicity compared with other means of publicity, he has referred to the company bulletin. In the United States we had quite a remarkable experience in that respect a few years ago. Mr. Kemble will probably remember it. A great many of the companies had a bulletin which they issued quite freely to their customers, and then when the dull times of panic in 1907 came, a great many of those bright little house organs were snuffed out of existence, and no means of resuscitation would bring many of those back to life. A few of the larger companies have resumed the publication of a monthly bulletin, but the number is quite limited, and it would seem that a serious doubt is entertained by central station managers as to the usefulness of that method of publicity.

There are other mediums which Mr. Marston has not referred to, on which I think from such an expert we would like an expression of his views. For example, bill posters; posters in windows; exhibitions to the public of devices in operation; the patronage of electrical exhibitnons—how far it is wise to go in expense of that character. Then there are leaflets and dodgers and letters of a circular character.

I was in the house of a friend not long since when his electric light bill came in, which he thought was very unreasonable. In the letter

were two circulars recommending different devices, and it seemed to me that the effect of sending those little circulars was that he did not use the devices to which his attention was called.

Personally, having had a little to do with newspaper publicity, I would like to second most cordially and heartily the views Mr. Marston expressed with regard to the decent treatment of the newspapers. I think they are just as willing to give us a square deal as we are to give the square deal to the public, and I myself am in hearty sympathy with the newspaper man who sees a publicity enterprise like a public utility or industrial concern trying to "get under his guard" and use his newspaper columns with what is nothing less than so much advertising matter. It is not fair or square, and I am glad to know that the central station managers seldom indulge in that practice. We use the advertising space freely and tell our own story in the way we want it told. I have been very much gratified to see the extent to which the central station companies on my side of the line (although I think I can claim both sides) have turned to the newspaper columns with their appeal and have told a straightforward story as to their difficulties and as to the arguments they have to present, and the reason why they have endeavored to get the public lighting contract, and the reason why they should not have bad legislation enforced against them—and a great many other things. The time has arrived when the central station industry can court the fullest light of publicity, and let us get all of it we can.

Mr. Kemble: I have been very much interested in hearing Mr. Marston present his paper, and still more so in Mr. Martin's remarks on it. I presume it is generally understood that Mr. Martin's references to company bulletins meant advertising bulletins, not the section bulletins, or bulletins issued primarily for home consumption. I note with a great deal of pleasure his paragraph on page 5 referring to advertising with reference to the selection of business. That point I am taking up in a paper which will be presented to-morrow, but it gives me a great deal of pleasure to find a man with his experience in advertising recognizing the necessity for guidance in the selection of and canvassing for new business.

Mr. I. H. Wright: In connection with advertising commercial apparatus in small towns, the rules that apply to cities do not always apply to towns. The ideas which the editors of city papers have are not instilled into the editor of the town paper. He is not a big man, as a rule, and consequently we do not look for the same benefit from local advertising in the papers.

Now, in our experience in advertising commercial apparatus of this nature, while we do, of course, patronize our local papers, we find it more profitable to get into touch with the individual customer with pamphlets and so forth. I regret that mention has not been made regarding the cooperation of the manufacturers in this respect. I want to express my appreciation as one of the many for the assistance received from that direction. All we have to do is ask for certain things in connection with

advertising their particular apparatus and we get it. Now, the majority of them issue special pamphlets that cost them a great deal of money. They are illustrated profusely and the cuts are excellent. We can also get these cuts independent of the pamphlets from the manufacturer, and all these things can be used to advantage. Then, in addition to that, I would say there are certain lines of large bill poster advertising which are more or less profitable which we are adopting at the present time in North Bay. They are canvas, painted on both sides. We erected one the other day about twelve feet by fourteen feet, in a prominent place, and illuminated it, and this brings in a good deal of business. Now, in addition to this, we have a man who inspects the wiring and inspects the condition of the system generally. He gets in touch with the individual customer, takes advertising matter with him and leaves it in the house, also exhibits the nature of the apparatus. This, of course, is followed up from the office. He gets in touch with the customer and finds out what he wants and reports it to us. These are some of the things which can be done in the smaller towns, and in our experience we find a marked increase in the day load, so much so, in fact, that we have to boost our voltage on certain days when they are doing most of their ironing.

Mr. J. H. Larmouth: There is a great deal of truth in what Mr. Wright has said about newspaper advertising in the small towns, and I have come to the conclusion that I do not think there is any branch of the business where you can waste more money than in advertising that is not done judiciously. In the smaller towns, I believe, the people do not read the advertisements in the newspapers to the same extent that they do in the larger cities, and the remarks Mr. Wright has made are very much to the point. In small places a personal canvasser gets very much more closely in touch with the individual and is able, I think, to sell more apparatus and more current than you can do by putting money into newspaper advertising. We are establishing a very complete system of card indexing in a number of our towns. We have a card to represent each householder in the place, and anybody who is a customer is tabulated on a white card, and those who are not customers are tabulated on a green card, and it is the object of the solicitor to change every one of those green cards into white cards. In this way we find we get very much better results than by advertising so much. However, we do sufficient advertising in the newspapers to keep them in good humor.

The President: Since I have been in the Association I have always preached that every man who comes to a convention should come with some definite object in view. That is, he should come in search of some particular information and should see that he gets it, and in that way get real benefit from his attendance. At this meeting I have some object in view. There are some kinds of information I want to get, and there are officers of the company to which I belong who are here, and I wish them to get certain information. Now, among the things upon which I

wish to hear the opinions of other operating companies is one which some of you may have considered already. That is the question of assisting in the wiring of houses for electric lighting. I don't mean assistance by presenting to the consumer something for nothing, but by assisting him with the advance of funds to pay for fixtures and wiring, and giving him a long term to pay it back in instalments.

Now, when you have reached several classes of customers which are more or less easy to reach, the field is pretty well covered, and you are getting into a class of householders which in many places it is considered impossible to get because of the small revenue they receive, and you meet a real difficulty in the cost of the wiring. Many would be disposed to use light if they could only have the wires in their houses. Now, we have been considering in our company a plan for assisting these people by selling them fixtures at a very low price and making arrangements with the contractors to put them in. We propose to pay these contractors in cash, getting the lowest rates, and to charge the whole thing to the consumer, who will make a small cash payment, and then pay the balance in instalments. We are impressed by the fact that many articles which are quite expensive find their way into the houses of workingmen and men of very small means absolutely because they are sold on the instalment plan. Sewing machines, washing machines, and even pianos, find their way into all kinds of cheap dwellings because of the easy conditions of payment that are afforded. We feel something can be done in that respect. The company would have to advance a certain amount of money to be repaid to it inside of a year. Naturally when you go into a venture of that kind you like to hear what other people in the same line of work think of it, and if there is anybody here who can throw any light upon the subject I would be pleased to hear it.

Mr. Marston: In connection with your last suggestion, as to securing this house wiring business, I may say I have done quite a little work in connection with that during the past year. I have in mind one town where we wanted to go out and do wiring, and the company had been more or less backward and had not gone out for the business. We found in that town there were two hundred empty houses—a town of about eleven thousand people—and we found that out of those two hundred empty houses there were five which were wired for electric light. In other words, the people when renting a house rented a house that was wired. We played that for all it was worth. Then we started out and made a proposition that we would wire any five-roomed cottage in the city for $13.50 cash or $15 on time payments, I think it was. They were to pay $2 down and $1 a month. Or we would wire complete with fixtures for $28, allowing for nine outlets. Now, that is not a low price at all, yet the first advertisement we published brought us in over $200 of wiring in two days. The cost was $6; $3 each in two newspapers. In addition to the profitable wiring work there was the increased load we got. Now, my idea in advertising wiring of this

sort is to follow out the same plan of advertising that the instalment man has followed out. He has made a success of his business, and we cannot do better than to follow him. The $4 down is not a big thing, and all they see is the $4 this month. They think if they can stand $4 this month that they can pay $2 the next month, and they will jump at the proposition, where they wouldn't think for a minute of going in for a $28 proposition on wiring alone. The proposition for wiring and fixtures was $4 down and $2 a month. We got a tremendous amount of business out of it.

In connection with the suggestion that some large companies find that newspaper advertising doesn't pay, I would like to say properly conducted publicity of all kinds does pay. Newspaper advertising cannot always be considered merely in its relation to the direct dollars and cents returned from a specific advertisement, but it must be considered in its relation to the newspaper itself and in its relation to the general feeling of the public. If newspaper advertising is conducted in a proper way along those lines there is no question but it must pay.

One of the great troubles with the central station industry to-day is the public do not know enough about it. They do not know what we are doing and they do not know why we are doing it, or how hard we are working. All they know is that the wheels go around, and when they go around they get the light at the other end, and they think it must be an easy job. That is the general idea, and we must get it out of their heads. There are a great many who question whether any advertising pays. The first effort, of course, is to make each advertisement pay for itself. Put the advertising and publicity department on a self-supporting basis. That is the principle on which I operate in every case. When I put out a house wiring proposition I want to put out a proposition that is going to make that specific proposition profitable, and when I put out a window advertising proposition I want to put a proposition that will appear in the window that will appeal to the passer-by enough to make that advertisement pay; and so on all down the line. Mr. Martin has given me material for about a ten or twelve hours' talk, but I do not think I will take up that much of your time. I prepared this paper for the purpose of bringing out discussion, and I am very glad I did, because your ideas communicated to one another are just as valuable as anything that I could tell you. You have all got your own problems. This question of publicity is not a question of laying down a set of rules; it is applying your own ideas to your own individual conditions. You cannot get any canned publicity that is going to do you any good. The first question that Mr. Martin brought up was one as to the value of billboard advertising. Now, billboard advertising comes under what is termed in advertising parlance general publicity. You can't put any more than eight or ten words in a billboard advertisement to be effective. You have got to have something that hits a man in the eye, that he can look at and get the whole idea. You have got to get something that people can catch going along in

the train or the street car, or motor car, if they have one, and therefore billboard advertising is of value only after a strenuous campaign of specific publicity has been made directing the attention of the public to that phase of your business, and this phase, and so on, taking up each phase. Then when they are sufficiently familiar with the subject take your billboards and put them all over, so that the people can't get away from the fact that there is something to this electrical business. In regard to window cards, perhaps the same thing applies. It is a thing that must contain few words or else it must be surrounded by a display that is sufficiently attractive to make a man stop and read it. If it does not do this it is no good. The matter of exhibition display rooms is one of very great importance. I have never seen a properly conducted display room yet that was not of value to the company. Sometimes they are not self-supporting, but in a great many cases they are. However, even if they are not self-supporting they have a value to the company. In regard to electric displays, I found recently that four or five years ago they were very popular in Great Britain. Nearly every company had an electric exhibition of some sort, and then they began to drop out, and about a year and a half ago there was practically none of that being done. They found they had entailed a very great expense, and in some cases the returns were not sufficient to justify the expense. Now, I am not inclined to agree with that experience at all. I have found that electrical exhibitions, or taking booths in your home exhibitions, or fairs of any sort, when they are properly conducted, are bound to pay; and that applies to the whole question of publicity and advertising by central stations. You cannot take one man's failure, because he may not know how to conduct a campaign profitably, you cannot take his failure as a reason for your own failure. If you do not know the business, get somebody that does, and you will make a success of it. There are a lot of very fine operating men who are not good advertisers. Some men cannot go to their own city council and get any concession out of them. Why? Because he knows more about making wheels go round than making the council go round, and he ought to have a man who is able to do that. Circular letters are always of value, but it is a question when the proper time arrives for sending them out. A monthly circular letter is a very good thing. I was very much struck by Mr. Martin's suggestion as to dodgers and advertising matter about the use of other appliances going out with the bills. It was only a couple of days ago that I prepared some matter to go on the back of a set of bills, and I had that very same idea in my own mind, only it was not quite so clear as it is since Mr. Martin's remarks. At that time I prepared an advertisement for electric signs. I did not put on that advertisement that a man ought to put in an electric sign. These bills were going out to all the customers, and the idea I put on the back of them was: "When you go down town take a look at the electric signs; look at the windows that have got the lights in." In other words, I was working a little reflex

action. If you get the customers to go down town and look at the windows that are electrically lighted it is pretty certain that the merchants are going to light up so they will get the benefit of that advertising that you are giving the fellows that are advertising.

Mr. Kemble wanted to know whether I considered the hydro-electric system was a hobble skirt, and I want to say I do. The hydro-electric system is going to hobble the central station industry here more than anything else I can imagine. Unless we get rid of that kind of competition, just as the fashion makers are going to get rid of the hobble skirt, we are going to be up against a serious proposition.

The field to be discussed in this matter of publicity is so broad that I cannot cover it, and I do not think we can cover it. If I had taken up all these subjects I would have had a paper that you wouldn't listen to. What I wanted to do was to bring out discussion on the question of publicity. It is extremely important that everyone of us should take the opportunity to tell our story to the public. Get hold of the newspaper editors, even if they don't like you. There are a lot of things sufficiently interesting about your business which they will be glad to get. Mr. Wright suggested that the editor in the small towns was not a big man. Now, I want you to bear in mind, the smaller the man the lazier the man, and the happier he will be to get something you have written out about your business so that he will not have to write it out himself. Those fellows are tickled to death to fill up space, and they want somebody else to do it. Get him up something that is catchy and interesting and he will take it and set it up and run it for nothing. I think that covers most of the questions that were asked with regard to the paper.

Mr. Black: I would like to ask Mr. Marston to what extent cartoons have been used. I know of no better way to influence the public mind than by a cartoon. I have come to the conclusion that a great many people are lazy and they will look at a picture or a cartoon and get the news of the week when they wouldn't read an article.

Mr. Marston: I have found it is very easy to use cartoons, and very profitable too. I had occasion to be down in a southwestern city about a year ago, or a little more than that, where two of the newspapers had cartoonists, and I got next to them. I got them started on fan stuff and the next thing we knew we had no fans to sell, and most of it was done right through the cartoon. Mr. Black has said that the public is lazy and does not like to read through a column. That is one of the most important things that has been brought up, and I am glad he suggested that. Whenever you have a story to tell to the public make it short. People will read an article three inches long quicker than they will if it is three feet. Put it in short.

The President: Our time is up that we can devote to this discussion. Mr. Marston's remarks have been very practical and the information given will be useful to our operating companies. This information is all the more valuable because it is the result of his

experience, which has been extensive, and after all, experience is the test of all these matters. I wish to tender to Mr. Marston, on behalf of the Association, our very heartiest thanks for his paper, which is one of very great practical value. As we have some important papers this afternoon we will adjourn so that we may get started on time.

AFTERNOON SESSION.

At 2 o'clock p.m. the President called the meeting to order, and asked Mr. George R. Smith, of the New York Edison Company, to read his paper on "Service Protection."

SERVICE PROTECTION

George R. Smith
New York Edison Company

To the central station the meter bears practically the same relation to income and ultimate prosperity as does the cash register or money drawer of the consumer in whose premises the meter is installed. As a rule, however, there is a considerable difference between the care which the central station exercises in protecting its indicator of revenue and that practised by the merchant.

The problem is not necessarily one of apprehending those who steal and their prosecution, but to remove, as far as possible, the temptation, increase the metered output, and eliminate legal complications that add materially to a central station's cost of production and frequently engenders a hostile feeling in the community which does not comprehend the true facts in the case; a feeling usually detrimental to the central station.

While it is a fact that those who illegally use energy are generally of a class whose credit necessitates a deposit before the installation of either service or meter, nevertheless there are many who, while they would not deliberately remove the insulation and make a permanent illegal connection to a service wire, would connect a part or all of their installation to an exposed branch block or service switch when necessary to have temporary service and which might prove so convenient as to remain permanently.

The question of adequately protecting the meter and service from tampering is, therefore, an important one and many central stations are now installing tamperproof devices for both the meter and the service which are proving highly effective in preventing interference, intentional or otherwise, with the company's apparatus, and also provides a standard method of installation.

The following paragraph relating to the subject has been taken from the "Installation Rules" of one of the large lighting companies:

"The company provides and installs all cut-outs which are required at the service on the service side of the meters. These cut-outs are of a sealable type, and they remain the property of the company, whose imprint they bear and by whom they are maintained.

"These rules require that all conductors on the service side of a meter or meters shall be run in metal conduit. This necessarily precludes the use of wooden moulding or of exposed wiring on any part of an installation in advance of the meter. No objection is, of course, raised to the use of exposed wiring or wooden moulding, provided their use is limited to the metered portions of an installation.

Fig. 1—Group of Westinghouse Induction Watthour Meters equipped with Metropolitan protective devices showing application of cutouts, wiring frames and sealing devices.

"Either method of wiring can be employed (provided it meets with the approval of the city authorities) if the line or lines are extended to a point where the service enters the building, and provided a satisfactory location for the meter or meters can be found at this point."

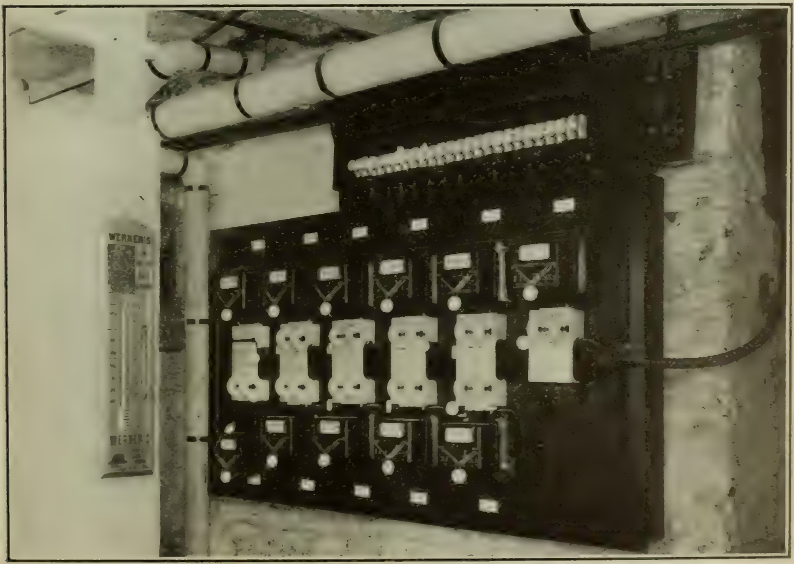


Fig. 2—Group of General Electric Type "I" and Westinghouse type "C E" Induction Watthour Meters equipped with Metropolitan Protective Devices showing application of cutouts, wiring frames and sealing devices.

The protective devices described in this paper were designed to include this as well as other important features in the one device and are now used extensively. They formed an important section of the meter exhibits at the convention of the National Electric Light Association at St. Louis, and of the Association of Edison Illuminating Companies at Frontenac, and will be described at length in this article. Included in this line are: sealable service entrance cut-outs; sealable combination service and meter-testing cut-outs; service distribution cut-outs; refillable porcelain fuses; terminal protectors; non-magnetic wiring frames for meters; seals, etc.

Cut-outs:

Sealable service entrance cut-outs are made in capacities up to and including 200 amperes, and when used in conjunction with flexible or rigid metallic conduit make an admirable installation calculated to prevent the theft of energy or unintentional interference with the company's service. This is especially so of the service distribution cut-outs which are either of single or double branch design, as shown in figs. 1 and 2. The combination service and meter-testing cut-out, as its name implies, performs two functions, that of a service cut-out and a meter-

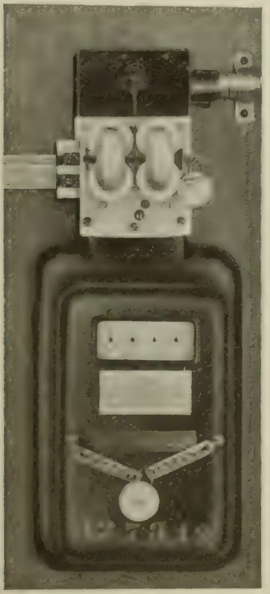


Fig. 3—General Electric type "C" Direct Current Watthour meter equipped with Metropolitan 2-wire meter testing and service cutout, wiring frame and terminal protector and sealed.

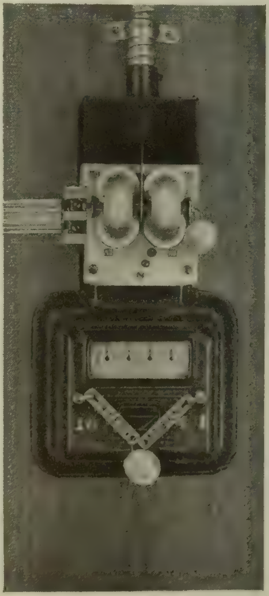


Fig. 4—General Electric type "I" Induction Watthour meter equipped with Metropolitan 2-wire meter testing and service cutout, wiring frame and terminal protector and sealed.

testing device, and it is illustrated in connection with complete equipments for different types of meters in figs. 3, 4, 5, and 6.

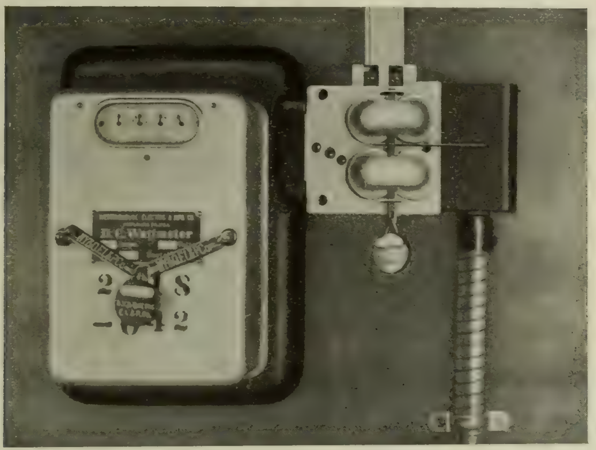


Fig. 5—Westinghouse Direct Current Watthour meter equipped with Metropolitan 2-wire meter testing and service cutout, wiring frame and terminal protector and sealed.

Fig. 6—Westinghouse type "C E" or "B" Induction Watthour meter equipped with wiring frame, 2-wire service and meter testing cutout and sealed.

Fig. 7—Metropolitan renewable Porcelain "U" shaped and colonial type fuses.

Fig. 8—Metropolitan renewable screw plug fuse with slotted head for sealing.

Fuses:

The fuses shown in figs. 7 and 8 are in an hermetically sealed porcelain enclosure and have several features distinctive from the ordinary type of fuse. They are made in the standard "Code" requirements and have been approved by the National Board of Fire Underwriters, and several tests have shown that the claims of the manufacturer are fully justified. They will withstand disruptive effects to a high degree. The tests showing this were the basis of a paper read at the National Electric Light Association's convention at St. Louis, "The Use of the Oscillograph in Fuse Testing," by Alexander Maxwell, excerpts of which are given below:

"The quality of a fuse is determined by the reliability of its calibration, or rating, and by its performance when opening a circuit under overload condition. The calibration is determined by the current which the fuse will carry continuously without undue heating, and by the time required to open the circuit under various overload conditions. These characteristics are quite easily determined by simple tests and are not affected by the constants of the circuit in which the fuse is placed. The overload performance is the most important measure of the value of a fuse, and a short-circuit close to the terminals of a source of supply is, of course, the most severe overload condition.

"In this investigation the fuses tested were of the all-porcelain type. * * * * These fuses were particularly suitable for an investigation of this character on account of their remarkable performance on short circuits and on account of the further fact that they are entirely sealed, making the test depend altogether on the internal action of the fuse. As there is no venting of gases or solid matter, possible

irregularities in the performance of the fuse, due to such venting, were avoided.''

The receptacle for the fuses, as shown in fig. 7, is also a departure in that the barrier scheme of protection between opposite polarities is used. This, with the ''U'' form of fuse, makes a service appliance which is peculiarly adapted to low-tension work, owing to the ease in handling and the fact that the fuse element may be replaced indefinitely at a low cost.

Terminal Protectors:

Terminal protectors are made of pressed steel and are so designed as to cover and protect the conductors at the point of junction with cut-outs or conduits. Removable ''knock-outs'' are provided on either side, end or bottom, for rigid or flexible conduit.

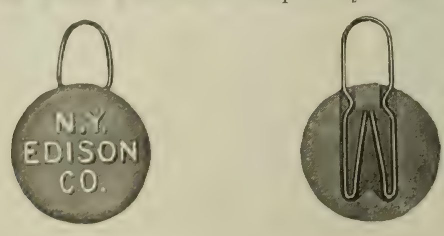
Fig. 9—Metropolitan out of service wiring frame for protecting meter locations where the meters have been temporarily removed.

Fig. 10—Group of General Electric type "C" Direct Current Watthour meters showing the application of protective wiring frame.

Meter Frames:

Meter frames are made of zinc stampings, are non-magnetic, and are used to protect the wiring around the meter. They are designed with a standard nozzle for either service or meter-testing cut-outs, as shown in figs. 1 to 6, or they may be had without any openings, as shown in figs. 10 and 11; these latter being used where the wiring enters or leaves through the mounting board directly behind the meter.

A "dummy" or out-of-service cover, as illustrated in fig. 9, is provided for use where a meter is temporarily removed from service



(Closed) Type "A"

Fig. 11—Metropolitan type "A" porcelain seal for service protectors, meters and instruments, also showing a cross section view of the interior.

(Closed) (Open)

Fig. 12—Metropolitan metallic seal and porcelain breakable button for service protectors, meters and instruments, also showing exploded view.

owing to disuse. When the meter is removed, the ''dummy'' cover is installed in its place, the service wires being inserted under a short-circuiting terminal inside the cover, thus preventing the fusing of the line by unauthorized persons. This ''dummy'' cover also obviates the necessity of removing the service wiring and its eventual replacement, as the service wiring in the immediate vicinity of the meter is not in any way disturbed, but merely protected. Posters of a design similar to that shown in the illustration may be applied to inform prospective consumers where arrangements may be made for service connection.

Seals:

Increased attention is now being given to the subject of having meters and similar devices adequately sealed, and the majority of central station managers now realize that this is an important feature and one that requires the best appliance obtainable. Several devices of this character have within recent years been placed on the market and the most effective are those of the type here described, which are made in two designs: the all-porcelain seal with metal shackle, and the metal seal and shackle with porcelain breaking button, as illustrated in figs. 12 and 13. In the all-porcelain design the seal is so constructed that the barbs of the metallic shackle when driven home engage the interior walls of the seal and cannot be withdrawn except by breaking the wire or the porcelain seal itself; a procedure which would on the next inspection of the meter indicate that tampering had existed. The metallic type of seal is essentially the same in principle as the porcelain seal. It is of metal, having a breakable porcelain button through which the shackle is passed, and this seal may be used indefinitely by installing new breaking buttons. On the obverse or reverse side of either type may be placed the name of the company, trade mark, copyright design or such identification marks as may be desired.

Installation:

The meter and device may be assembled and wired in advance in the supply department and sent to the consumer's premises ready for connection to the service. This is an advantage in that it makes unnecessary any extensive meter installation work on the premises of the consumer, and it also permits the wiring and assembly to be done at a

time convenient to the central station, and by other than expert wiremen.

Meter Tests:

As previously stated, the development of service protectors has been carried along lines to facilitate and accelerate the testing of

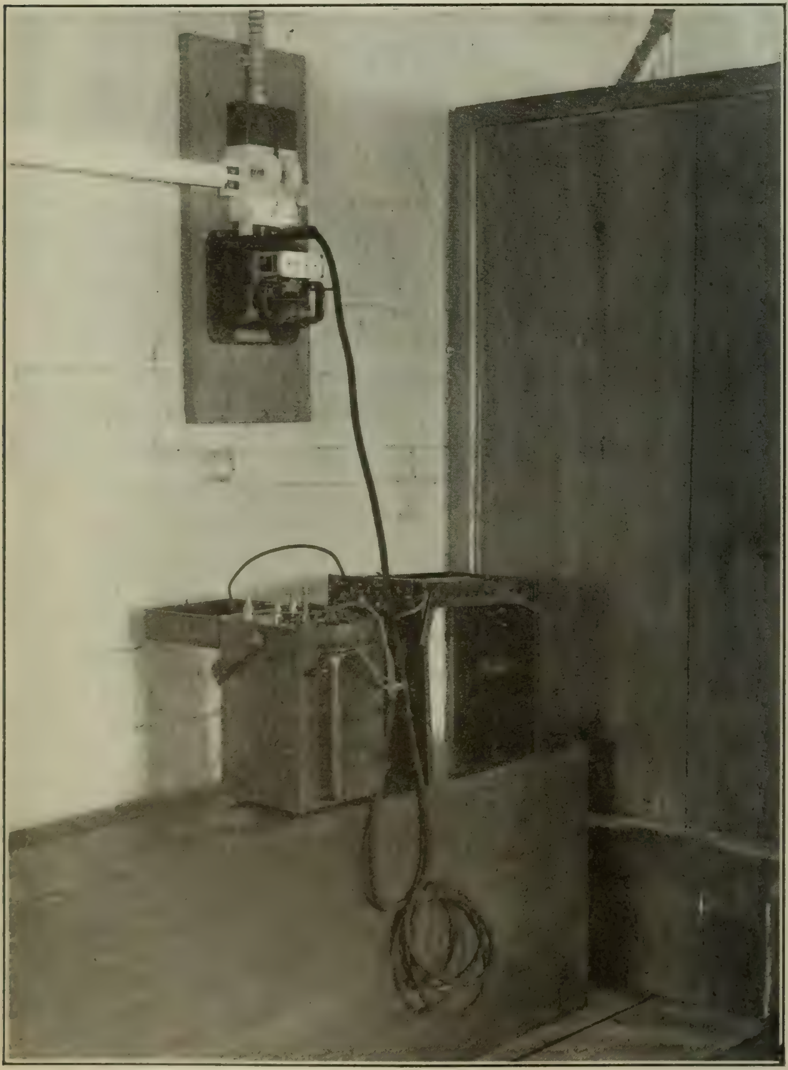


Fig. 13—General Electric type "I" Induction Watthour meter equipped with 2-wire service and meter testing cutout with testing plug inserted and connected to calibrating instruments ready for test.

meters, and at the same time without in any way interfering with the functions of the device or affecting the continuity of the consumer's service; this latter feature being of particular value where translating devices, such as motors, arc-lamps, Cooper-Hewitt lamps, etc., requiring an unchanged polarity are in circuit.

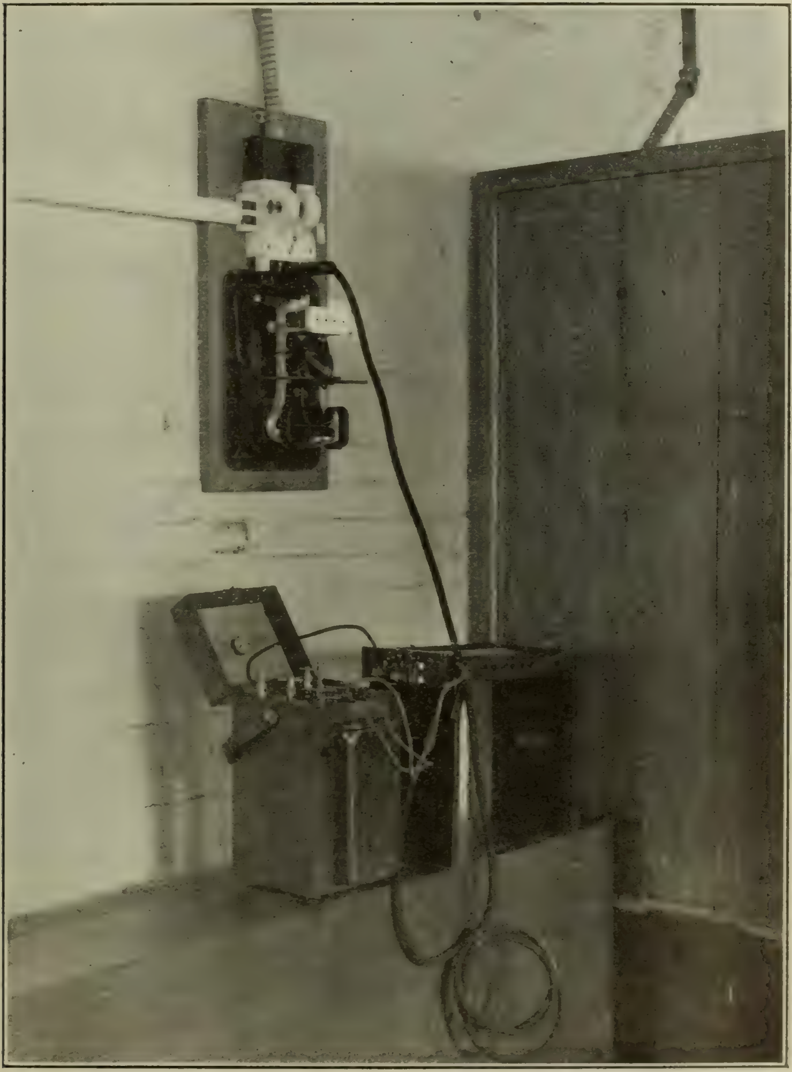


Fig. 14—General Electric type "C" Direct Current Watthour meter equipped with 2-wire service and meter testing cutout with testing plug inserted and connected to calibrating instruments ready for test.

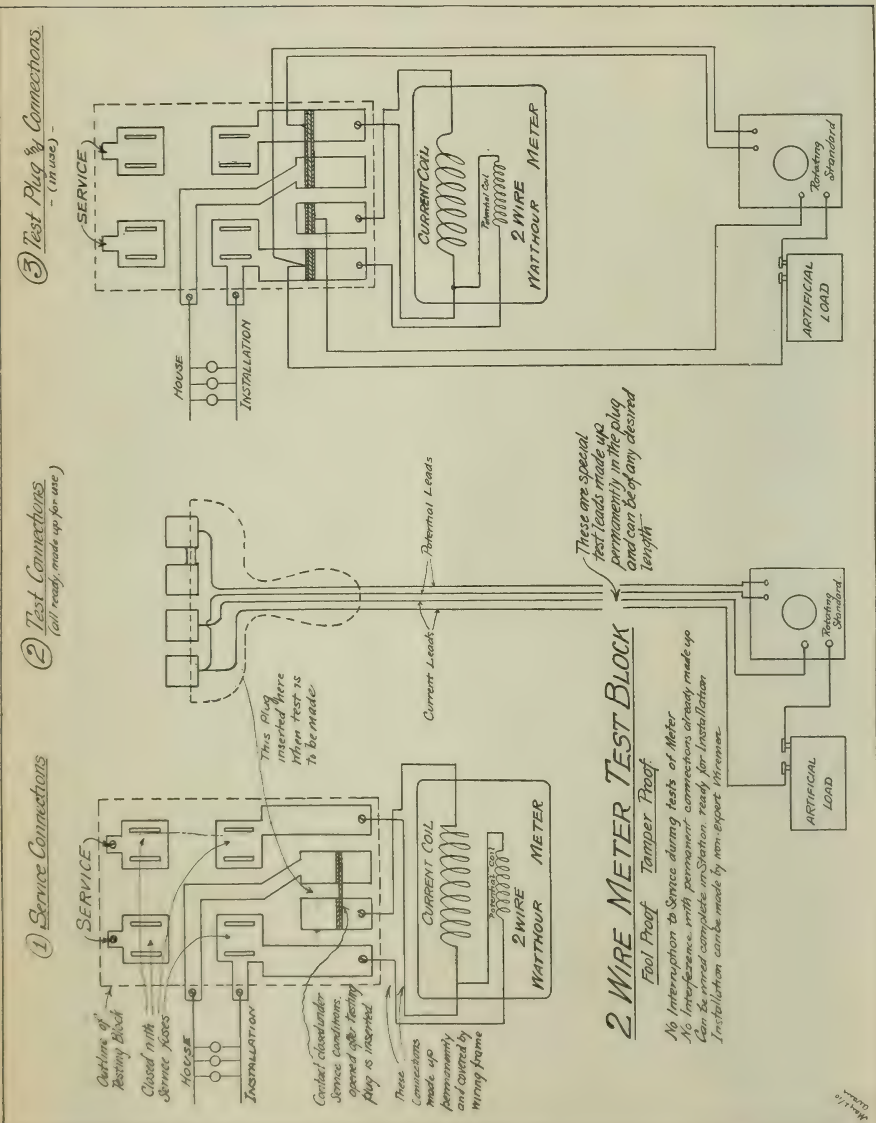


Fig. 15—Diagrammatic scheme of both service and testing connections for 2-wire meters.

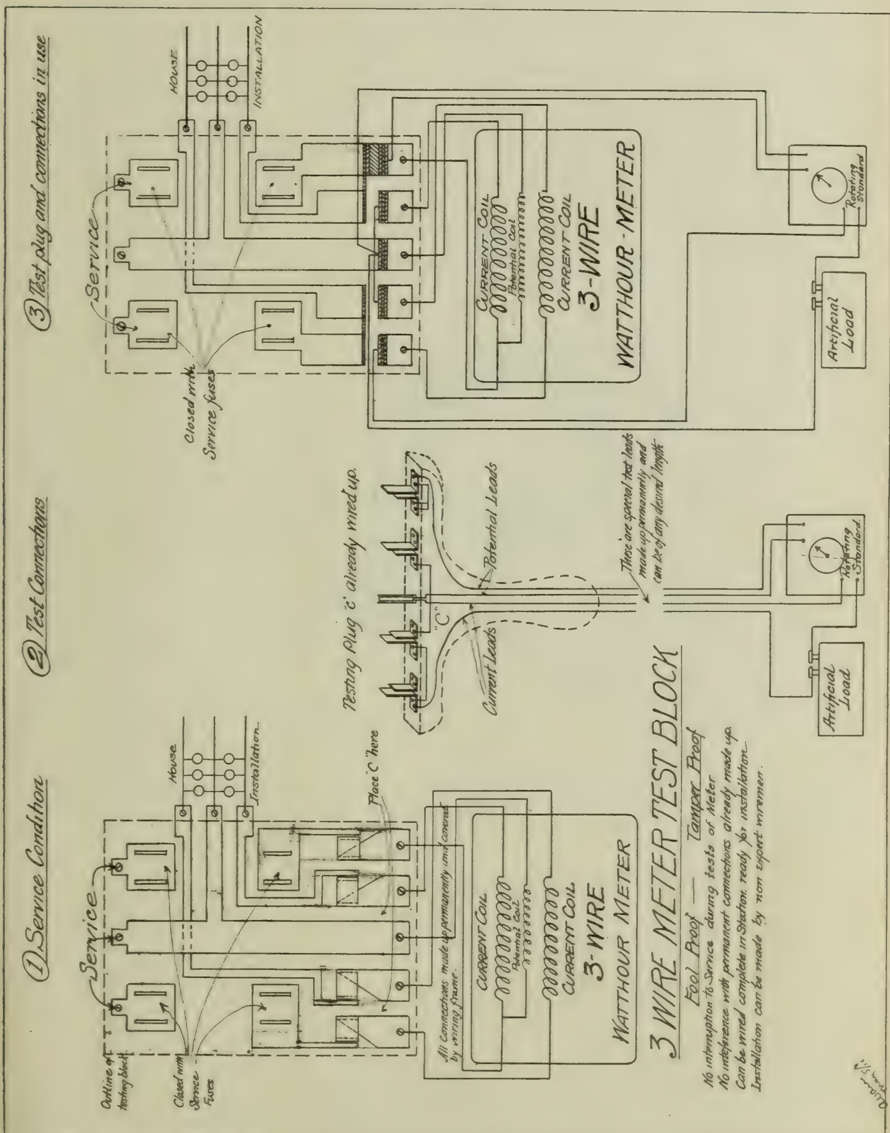


Fig. 16—Diagrammatic scheme of both service and testing connections for 3-wire meters.

To safely by-pass the consumers' installations, maintain the same polarity, place the meter fields in series and make such other connections as are necessary in preparing the meter for test, at the same time not disturbing any permanent connection, all of this being done by one simple operation, is the advantage which this device offers. The meter-testing plug (fig. 17) to which is attached a four-conductor cable for connection between the meter and the rotating standard test meter or instruments is shown in position ready for the test on the meter in figs. 13 and 14, while the diagrammatic scheme of service and testing connections is illustrated in figs. 15 and 16. It is at once apparent that this combination of service cut-out and meter-testing block and the ease with which the calibrating instruments may be connected in circuit will greatly simplify tests and materially increase the number of meters tested per day per man.

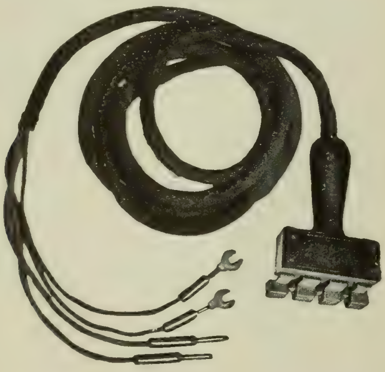


Fig. 17—2-wire meter testing plug, cable and terminals for connection with instruments or rotating standard test meter.

Mr. Smith: I should like to add that service protection is becoming more necessary as the consumer becomes more familiar and experienced in the use of electric energy.

DISCUSSION.

The President: This paper deals with a very practical subject. As the author has very well said, the need of protecting devices is getting more apparent every day. People perhaps in the beginning had some sort of fear of electric appliances which prevented them from interfering with them, but operators of electric light companies know that a great many people have got over that condition and that they now do not hesitate to tamper with these devices when there is a chance of not being caught. The designing of devices which will overcome that is not so easy as it might seem at first. The more you look into it the more difficulty there seems to be in producing a device which will ade-

quately do the work for which it is designed. Any device which will lead to some system which can be uniformly adopted will be of benefit to the central station.

Mr. Pack: This paper opens up a wide field, and there should be ample room for considerable discussion. I should like to know what experience some of the other companies have had in using a definite set of rules for customers' installations. Can they get the wiring contractors and others to live up to them? Then, in the event of competition, is it possible to enforce a definite set of rules regarding customers' installations, interior wiring, where the meter should be installed, and so on? It would seem that devices similar to this, or affording similar protection, would be of great use to the central stations, more especially in the larger cities, where undoubtedly a very large theft of current takes place annually and where the loss must be quite considerable.

Mr. L. V. Webber: The question frequently arises of current being stolen, and whether it pays to instal a device for protection, such as has been described, and to what extent it would be advisable to use it. It is not an easy matter to tell if it would pay, because nobody knows exactly how much current is being stolen. It would be a good plan if the central stations adopted some system of protection and put it on in suspected cases. I think in that way perhaps we could get hold of the offenders in a cheaper way than by adopting it to every installation.

Mr. G. R. Smith: Mr. Chairman, it may be of interest at this time to know that by the installation of some 1,100 of these ''Metropolitan'' protective and meter-testing devices on their system, the Electrical Department of the Municipal Gas Company, of Albany, N.Y., have reduced by over 50 per cent. the unaccountable losses at their station meters. They hope to further reduce these losses by equipping their entire system with devices of this character.

Mr. F. A. Chisholm: In answer to Mr. Pack's question regarding making standard rules for customers' installations, I have tried that and I found it did not work. You cannot get them to lay out installations with regard to standard rules and just where you want them, much less with service wires and meter installations. We have decided to instal protectors gradually on every meter we have. We will instal them in suspected cases first. We found that there was a great deal of stealing going on, and we now have cases coming up in court against three customers. We have concluded to change over just as soon as we can, and run all service wires in conduits.

Mr. Garner: Apart from the stealing of current by customers, I think it is a good scheme for the companies to enclose fuses and meters in metal boxes for their own protection, because some customers when their fuses blow out have been known to insert a piece of gas pipe in order to make contact and secure light.

The President: There is no doubt that this is a very serious question, to provide adequate devices for all your customers. It represents a very large outlay, and undoubtedly the best way to begin is by covering suspected cases, and if those increase and you get evidence that there is a good deal of interference, or stealing, to call it by the proper name, then you may judge it will pay to instal them throughout. I believe it is a fact that we do not know how much is being taken, and some companies are resting content in the belief that there is very little of that going on, simply because they have not sufficiently investigated. I know in our case investigation showed that the practice was a great deal more common than we had suspected. There was a rather amusing case that occurred with us. A device was discovered in a house whereby current could be abstracted, and by a little detective work we were able to get proof that this device was being used and that current was actually taken through it. The case was brought up in the police court, and we had a very strong case. Some influential people began to intercede in favor of this man, who was considered to be quite respectable. They said it would be a very serious thing, and ruin his career, and the rest of it, and finally our hearts softened and we agreed to withdraw the charge, and I attended the court the next morning for the purpose of stating that we had decided not to prosecute, and to go as far as I could in order to get him out. When the case was called the magistrate immediately asked the man if he was guilty or not guilty, and I jumped up to say something, but before I could speak he said he was guilty, and that settled it.

Now, this is really a question we should study. I remember taking a case up with the chief electrical inspector of the underwriters in Ontario. Their rules provided that there must be a switch controlling the whole installation, and that that switch must be under the control of the householder so that he might, without appealing to the company, cut off the whole installation, and it stated that all connections must be inside of that switch. I proposed a plan whereby a switch would be put in inside of the meter, and it was so arranged that everything could be cut off except the shunt wire of the meter, and that would have to remain in circuit all the time. I tried to get the underwriters to agree to that, that if everything was cut off but the shunt wire we might be allowed to use it, but we couldn't get it. The matter was referred to headquarters, and it was brought up before the committee in New York, where the rules are amended from time to time, and the committee would not consider it at all. If that ruling is persisted in it will prevent the use of any kind of a device, it seems to me.

Mr. G. R. Smith: Mr. Chairman, service protection is becoming more necessary as the consumer becomes more experienced in the uses of electricity, and it would, therefore, seem advisable to entirely remove the temptation for theft of current rather than to be obliged to prosecute a consumer, a procedure which is both costly and prejudicial to

the central station. The value of a device, providing this protection as well as affording a quick and economical method of testing meters, is readily seen.

The President: On behalf of this Association I wish to thank Mr. Smith for his very interesting paper. I will now ask Mr. Pack to read the paper on ''General Accounting'' which has been prepared by Mr. C. E. Bowden. Mr. Bowden is not able to be present.

Mr. Pack: With the permission of the President, I will read the report of the Committee on Uniform Accounting first, and afterwards the paper by Mr. Bowden, in order to facilitate any discussion which may take place.

REPORT OF COMMITTEE ON UNIFORM ACCOUNTING.

To the Members of the Canadian Electrical Association:—

Gentlemen,—Your Committee is not prepared this year to make any definite recommendations of a general nature, as it felt that until the central station companies in Canada were more generally educated on the subject of uniform accounting, and were more generally prepared to use the classification of accounts adopted by your Association last year, it would be unwise to burden them with further suggestions.

The Committee has, however, arranged for the presentation of a paper setting forth the great benefits and advantages that will accrue to the companies who will take the necessary trouble to have their books and accounts kept with sufficient detail to enable their directors and owners to thoroughly understand the exact condition of affairs from time to time, and to enable their operating men to pick out the weak spots, so that the plants may be operated, not only efficiently, but economically.

The Committee has felt somewhat disappointed that the companies in Canada have not taken a greater interest in the report presented last year, and the individual members of the Committee had hoped that communications would be sent to them from time to time, asking for help and assistance in carrying out accounting systems; while they would like to think that this omission is an evidence that the companies' accounting systems are thoroughly sound, yet they fear that, in many cases, it is rather due to a lack of interest in the matter.

Your Committee is happy to state that the Hydro-Electric Commission of Ontario has shown its intention to have its accounting systems thoroughly businesslike, and as sound as its engineering, and the Commission has signified to the municipalities that it thoroughly approves of the system of accounting which has been adopted, it being one that

corresponds very closely with that adopted by the various public service commissions in the United States, and by the National Electric Light Association and the Canadian Electrical Association, so that it may be said that, at the present time, in Ontario at least, the accounting systems of electric lighting and power stations, whether publicly or privately controlled, will be practically identical.

Now that the Canadian Electrical Association is in affiliation with the National Electric Light Association, your members will in due course receive the Report of the Committee on Uniform Accounting of the National Electric Light Association, together with papers read at the convention recently held in New York, covering a wide range of subjects. Your Committee would strongly recommend that this report and these papers be carefully studied.

Respectfully submitted,

(Sgd.) R. F. Pack (Chairman.)
D. R. Street,
H. R. Lyons,
F. A. Chisholm,
F. B. Warner.
Committee on Uniform Accounting.

GENERAL ACCOUNTING.

C. E. Bowden
Auditor Toronto Electric Light Company.

Some time about June, 1910, the railroads of the United States, operating east of the Mississippi River, acting in concert, filed with the Interstate Commerce Commission new tariffs providing for a large increase in freight rates. The Commission ordered a public investigation to determine the justice and reasonableness of the proposed rates, and pending the result of the investigation, suspended the operation of the new tariffs.

In this investigation Mr. Louis D. Brandeis, of Boston, acted as counsel for the Traffic Committee of the Trade Organizations of the Atlantic Seaboard.

The contention of the railroads was that they needed a greater gross revenue to offset the largely increased ratio of operating expense, which they claimed was due principally to higher wages. Mr. Brandeis' reply to this contention was that the need of the railroads was not a larger gross revenue, but a lower ratio of operating expense. He contended that if the principles of ''Scientific Management and Efficiency Engineering'' were introduced, economies could be effected which would result in very large savings. He placed this saving, on all the American railroads together, at one million dollars a day.

Now, it is the possibilities contained in this startling statement with which we have to deal. This problem of scientific management has become a very live subject in the public mind these last few months. Briefly stated, the efficiency movement, of which scientific management is a most important factor, expresses a new viewpoint, a new philosophy, in industrial management. It conceives of the conservation of labor and material—it deplores waste, believing it can benefit no one, neither consumer, corporation, nor employee—its goal is the total elimination of waste.

This goal can be brought nearer by careful study of conditions—by careful arrangement of machinery—by enabling men to work under more advantageous conditions. Under scientific management every department—every detail even—of a business is brought under the careful scrutiny of men trained to think—experts in their own particular line of work. The best method of doing each particular work, suitable to its own peculiar conditions, is determined on, and a standard of carrying on this work is set. It is apparent to all that if each company would adopt the best methods and practises now prevailing in every other company, that the operating expenses of each company would be very

materially reduced. But a far greater degree of economy would result to each company from the introduction of scientific management, under which the best methods and the best practises, suitable to the conditions of each company, could be determined on and adopted. Thus the efficiency of the entire plant would be raised to the highest possible degree, and efficiency in turn must produce economies.

Under this new order of things and these changed conditions, the position of the accountant has been raised, and the scope of his work greatly broadened.

Science of Accounting.

Accounting has been defined as that science which treats with the making of records which tell the financial condition of the company, which shows the efficiency of departments, determines the cost of each step in the whole operation of production, and enables the management to determine the earning power of the enterprise.

The science of accounting, like all other sciences, is an exact one, and has its own peculiar governing laws. These governing laws, in the case of electric lighting companies, are a practical and workable classification of accounts, to distribute and classify the various transactions of the business so as to ensure uniform treatment.

Most electric light companies now operate under a classification such as that adopted by the Canadian Electrical Association last year.

Broadly speaking—and a paper of this kind can deal only with generalities—the work of the accounting, or auditing department, as it is generally called, can be divided into two branches: First, the financial branch composed of the stock holders, presided over by the president and directors; and, second, the operating and production branch, presided over by the general manager and his executive staff.

The accounting features of the operating branch can be divided into three classes: First, a system of time keeping and pay-roll accounting; second, a system of handling and accounting for material purchased, or stores accounting; and, third, a cost system, usually called a working-order system.

Pay-Roll Accounting.

Pay-roll accounting in principle is a comparatively simple thing, consisting of keeping a record of the time the men work, of preparation of the pay-roll, and the distribution of this pay-roll to the various accounts affected. The method of keeping a record of the men's time is usually by means of a time clock or register. From this register the number of hours a man works is determined, and time slips, showing the kind of work the man has been engaged at, signed by the foreman, are sent to the pay-roll department. These time slips are entered in the pay-roll register and distributed to the various expense or plant accounts. From this pay-roll register the total pay-roll for the period is computed, and sent to the fiscal department, and at the same time a distribution voucher is made out, showing the total amount of labor

for the pay-roll period which was distributed to each account. This voucher is sent to the auditing department and entered in the general books of the company.

Stores Accounting.

Now, while care has always been taken to obtain a very full measure of utilization of labor, the same does not hold true of material. Companies which guard their money transactions with scrupulous care, often allow the handling of their stores, running into thousands of dollars, to be done in a very loose manner. Under scientific management, the same study is made to secure full value for money expended in material as in labor: care is taken to purchase only those materials which have been selected by careful tests as being most satisfactory and efficient for their particular purpose. A ledger account, or card index (called a perpetual inventory) should be kept of each article, and to facilitate this purpose a storeroom, arranged in bins, is recommended. Under this bin system, the storeroom is divided into a number of bins suitable in size to the kind of material handled. Each bin is given a number, and only one kind of material is placed in a bin, and this number, as well as the name of the article, appears on the ledger sheet or index card. This reduces to a minimum the confusion which is often caused in the inventory clerk's mind by an article being called by both its technical name and the one in common use. By the use of this bin system, each article can be accounted for as it is received, and vouched for as it is needed and given out, and the storekeeper can balance his records almost as accurately as a cashier balances his cash.

Thus loss, either in purchase of poor material, or through wasteful use, is avoided.

Cost Accounting.

In all cost systems, there are two radically different methods of arriving at the result: one to ascertain it after the work is completed; the other to ascertain it before the work is undertaken, and this second method is beginning to be used in some very large plants. The principal objection to the first method is that it delays information until it is useless as far as that particular job is concerned, and that it often mixes up with costs, things that have absolutely no connection with it. The advantages of the second method are very apparent. The cost of the work is ascertained before being undertaken, and the result after it is finished can be divided into (1) standard expense, or cost; (2) inefficiency and avoidable loss. An analysis of this kind immediately tends to minimize waste, and to steadily decrease standard costs. The importance of a system of this kind can hardly be over-emphasized—it is the radical difference between haphazard guess work, and an almost certain predetermined result, arrived at by scientific principles modified by experience.

This system of cost keeping is called a work-order, or job-order system. When a superintendent has a job on hand of a certain size,

usually one to cost $100.00 or over, he issues, on a form provided for that purpose, a request to the auditing department for a work order authorizing the work. On this form is an estimate of the cost, divided into labor and material, and on the back is shown how the estimate is arrived at. This request form is passed on by the general manager or officer authorized for that purpose, and when approved, is sent back to the auditing department. There a work-order is issued to the superintendent who requested it, authorizing him to do the work, and directing him to charge all time and material to the number on this order. This work-order is then entered in the work-order ledger, and charged to a plant or expense account as the case may be, and when completed, it is distributed to the proper account in the general books of the company. It will thus be seen that this system does two things—(1) it enables a standard cost to be determined, thus eliminating waste: (2) it enables the company to show accurately how plant values are arrived at, and more than this, it enables them to prove their accuracy and justice. For there is no real difference between charging the cost of a job with material or labor that was never used on it, and in charging up to it more material or labor than the work could and should have been accomplished with.

Statement of Income and Expenses.

REVENUE

City arc lighting	$
Residential Lighting	
Commercial Lighting	
Power	
Motor Rentals	
Arc Lamp Rentals	
Tungsten and Fixture Rentals	
Profit on Wiring and Sales	
Miscellaneous.	

WORKING EXPENSES

Generation Expenses
Distribution Expenses
Utilization Expenses
Customers' Department Expenses
Sales Department Expenses
Executive and General Expenses

Annual Charges

Insurance
Injuries and Damages
Rents
Taxes
Bond Interest

Balance Sheet.

ASSETS	
Property and Plant	$
Treasury Securities	
Stocks	$
Bonds	
Current	
General Supplies in Stock	
Bills Receivable	
Accounts Receivable	
Investments	
Stocks and Bonds of other companies	
Prepaid Accounts	
Taxes—City and Provincial	
Insurance Prepaid	
Telephone Rentals Prepaid	
Cash	
On Deposit	
In Bank	
LIABILITIES	
Mortgages Payable	
Accrued	
Taxes—City and Provincial	
Debenture Interest	
Rents	
Directors' Fees and Salaries	
Current	
Bills Payable	
Accounts Payable	
Unclaimed Dividends	
Customers' Surety Deposits	
Capital	
Capital Stock	
First Mortgage Bonds	
Reserves	
Contingent Account	
Depreciation Reserve	
Profit and Loss Balance	

The financial branch of the company is interested principally in the general condition of the business, and in the increase or decrease in gross or net revenues. This information is furnished by the auditing department through the preparation of a monthly statement of income and expenses, and also a balance sheet showing the condition of the affairs of the company on a certain date.

There are four main groups dealt with in every system of accounts, namely, Assets, Liabilities, and Income and Expenses. These may be roughly defined as follows:—

Assets—All tangible and intangible values existing at a certain time, amounts due the company, material in stock, etc.

Liabilities—All debts owed at a certain time, mortgages against the company's property, and obligations to stockholders.

Income—Revenue to which the company is entitled for its services.

Expenses—The cost of running the business.

The balance sheet and statement of income and expenses will help to show the relationship these groups bear to each other.

It will be noted that the total result of the statement of income and expenses, representing net earnings less any dividends that may have been declared, is included in the balance sheet as a liability under the heading of Profit and Loss Balance, for this represents an obligation to shareholders in the shape of undivided profits.

Transactions are constantly occurring, both between the company and its customers, and between different departments of the company's organization, which must be recorded in their proper accounts so that they may eventually find their way into the balance sheet. The compilation of this mass of transactions, and the recording of them in their proper accounts and thence to the general ledger, from which comes the balance sheet, is the problem with which the auditor has to deal. It is impossible to do more here than to outline the routine followed. Revenue statistics are taken care of by the customers' accounting department, which attends to the reading of meters, billing of customers, and the collection of any bad debts which may arise.

Working expenses are made up mostly of material and labor used in the operation of the company's plant, and executive and general expenses.

The pay-roll and material distribution departments voucher all labor or material which has been charged to operating expense or construction accounts through the month. These vouchers are entered into voucher distribution books by the auditing department, and posted into the general ledger.

All executive and general expenses are taken care of directly in the auditing department.

It will be seen that the auditing department occupies a somewhat peculiar position in that it is both dependent on and independent of other departments. It is dependent on them for the records of actual transactions, but independent in their final treatment and disposal. The responsibility for the accuracy and correctness of all information which finds its way into the balance sheet and statement of income and expenses must rest finally with it, so that it is an important duty of that department to carefully scrutinize and pass on the reasonableness of all information which it receives. While it is easy enough to dis-

tinguish between maintenance and construction charges in theory, it is not always easy to maintain that difference in actual practice, and eternal vigilance is necessary on this point, for if amounts were allowed to be charged to construction which were a proper charge to maintenance, it can be easily seen that both assets and net income would be inflated out of all proportion.

One of the greatest benefits accruing from any system of accounting lies in the opportunity for comparisons. Reports covering comparisons of any group of operating or maintenance accounts are of inestimable benefit to the management in determining whether proper results are being obtained from the work of the various departments.

Central station companies, supplying electric light and power, are at a critical point in their history at the present time. They are confronted on one hand by an increase in the price of labor, and almost everything that enters into the cost of their product, and on the other hand by a public sentiment which would certainly be hostile to any attempt to increase rates, and, indeed, one which is now demanding lower rates and attempting to enforce this demand by competition. The only remedy for this condition of affairs would seem to be reforms from within—the introduction of a scientific and systematic attempt to secure efficiency, and through efficiency the fullest possible results from every detail of the operation of their business. If this were done it could be confidently predicted that the saving to every central station in Canada would at least be many hundred thousand dollars a year.

DISCUSSION.

The President: The report of the Committee and this paper are now before you for discussion. The object of this report, which represents a great deal of work, is to furnish the central stations, without much effort on their part, with a means of ascertaining their true position, which is a thing we all need. It is a necessary thing to know not merely that there is an excess of revenue over expenses, and what that excess is, but it is also necessary to know the cost of each factor in the total expenditure in order to maintain a proper proportion between them. It is difficult for a central station working by itself to know whether any item of expenditure is more than it should be. It is only by comparison with other men in similar fields of labor that we may judge whether we are doing well or not, and when we find that we are spending too much money on some particular feature of our business, we can in this way find a means to remedy it. It is impossible, however, to make comparison of any value with other companies unless these companies use a system of accounting and distribution of accounts similar to your own. The only way to effect uniformity is by
counts similar to your own. The only way to effect uniformity is by
adopting the recommendations of this Committee, and the Association as a whole did its share last year when it adopted the classification

and recommended it for the use of its members. Now, you may devise better systems possibly, but it isn't likely, because the men who were engaged in this work made a thorough study of it and got all the data they could gather together and also got expressions of opinion from many members, but even if their system is not the best it has the advantage of the backing of the Association, which is the only way to secure uniformity. I would like to be able to see all the operating companies in this Association following that system and then we could get statistics of real value. We have a Committee on Statistics who have been gathering a great deal of data and doing a great deal of work, but the result of that work is minimized greatly by the uncertainty due to the fact that all the companies are not operating on the same lines. I cannot emphasize too much the importance of each company following this classification strictly. Objections have sometimes been raised that the system was too elaborate for many of the small companies, and while that is probably true, the system can still be used by these companies along general lines. It need not be carried so far perhaps in respect to the sub-division of the accounts, but the same general lines may be followed. A number of accounts may be grouped together under the general heading, but as far as a man feels he ought to go in classifying his expenses he should follow the lines laid down by this Association

Mr. Kemble: There is one point that is referred to in Mr. Bowden's paper to which I would like to refer, namely, the application of scientific management. It is rather interesting to note that the accounting department and the stores department are practically the only two departments in the central station business where the application of scientific management can be carried out to its logical end, for the reason that those are practically the only departments that always get their material with which they have to work in the same shape, and turn it out in the same shape. Therefore, we would expect from those two departments the greatest advantage in the application of scientific management, and for that reason I think Mr. Bowden is especially to be commended for calling attention to it.

Mr. Pack: I think that many engineers and technical men in operating companies have an idea that a more or less elaborate system of accounting is a waste of money and a waste of time, and that this elaboration is suggested by the accountants in order to make remunerative occupations for themselves. No engineer would operate his steam plant without a steam gauge and a vacuum gauge. He requires these in order that he may see what is the state of his boiler, and thus safely guide the operation of his engine. So it is with a business. You may possibly do without a more or less elaborate accounting system, but if you do you are running a great risk. You do not know where you stand. By having a proper check, and having figures constantly before you in such a way that you can readily see what has taken place, you can at

once pick out the errors in judgment that have been made during the past month, or note where the extravagances have taken place, and so on, and in that way a company is much more likely to be a financial success.

Now, it may also be suggested, especially by the smaller companies, that it is impossible for them with their limited resources to carry out these elaborate systems. In this connection I might say that two years ago I was asked to write a paper on store room accounting, having special reference to the small companies. I felt that the practice and system of the Toronto company would hardly be suitable for a small company with limited resources, and I got into touch with a small company in the Province of Quebec, whose representative I think is in this room to-day, asking him if he would help me to write that paper. The information I got from him was surprising. I understand his company is quite small, and yet he keeps his accounts in a way that would be a model to many large companies. It is quite within the powers of a small company to keep a proper system of accounting.

Mr. Chisholm: With reference to accounting in small companies, I may state that I do not think it is any trouble, and it cannot be carried too far. I have adopted the system that was proposed last year throughout, and I find it is just as easy to adopt in the smaller companies as in the large ones. Once you get your forms made out and properly started, the routine work is carried out every day, and at the end of the month it just takes us about fifteen hours to balance and close every book in the company, and get our reports ready for the directors' meeting. I think every small company should adopt a system such as this. I think they would find it well worth their while.

Colonel Street: There is certainly nothing to criticize unfavorably in Mr. Bowden's paper. He should be commended very strongly for bringing out in such a brief manner the intricacies, if I may so call them, of the system adopted by this Association. He expresses the fact that accounting has become a science. The man who is keeping books is not merely a bookkeeper; he can aspire to a higher sphere. Accounting has become a technical subject like other departments in electrical affairs. One thing for which Mr. Bowden should be particularly commended is for drawing our atention to the accounting of stores and the proper care of stores; every central station manager here will admit that there has been at some time or other a leak in that particular spot, and Mr. Bowden shows in a very clear way how to get over it. I would like to emphasize again the importance of the advantages to be gained by comparison. If every member of this Association would send in the figures to the secretary's office—not necessarily with the names, but perhaps by numbers—it would be particularly beneficial to everyone. Mr. Bowden has shown in precise form how the expenses can be boiled down under general headings.

Mr. I. H. Wright: I would not like to see this paper passed by without making mention of the stores. Mr. Pack and the gentleman who has just spoken have emphasized this, but we have not heard anything in this discussion which would apply to the small central station and how he is to keep track of his stores. A central station in a town with a population of less than 10,000 does not have sufficient stores to pay for the services of one man whose sole duty would be to look after the stores department. I would like to know if in the small central stations these methods apply, or if they could be applied economically in keeping track of stores so that we might have the assurance that we are not losing money in that particular branch.

Mr. Larmouth: It seems to me we cannot have too much detailed information with regard to the actual cost of operating. It is important to know the cost of your coal and oil, and the cost of your distributing lines, and pole lines, and everything of that nature. I like to see everything in my accounts for purely operating purposes worked out on a percentage basis every month, and compared with the previous month, and then the total for the twelve months compared with the previous twelve months. This comparison enables you to put your finger on the weakest spot, and the next month you are able to save a small percentage, and even if it is only one-half of one per cent. in taking care of your transmission lines or poles, it is worth while.

The President: I have to again record the thanks of the Association to Mr. Bowden for this paper. The best work is not always done here, but sometimes in considering these communications in leisure at our own localities.

If there is no further discussion we will now adjourn till to-morrow morning at 9.30 a.m.

SECOND DAY—MORNING SESSION.

On opening the meeting the President called on Mr. Wills MacLachlan, of the Trenton Electric and Water Company, to read his paper on "Some Notes on Central Station Management."

SOME NOTES ON CENTRAL STATION MANAGEMENT

Wills Maclachlan

Trenton Electric & Water Co., Belleville, Ont.

The central station, as we now see it, has been a gradual development from the early types of electrical stations, and, hence, the manager of such a station has gone through a very great many steps in his development. The writer feels that among the members of the Association are many central station men who have come up through these different steps and, hence, would be in a position to take up the details of this work in a way that would be impossible for him to do coming but recently from the work of a construction engineer. Yet with central station work, as with most other lines, the advice, or criticism, or ideas, of outsiders, or men in allied lines, is often of appreciable value. The idea of this paper is not to give an exhaustive treatise on central station management, but simply to outline a plan of discussion which it might be profitable to follow.

The modern central station man is coming in contact with a great many different classes and types of human nature. He has to combine in his make-up the faculties of a lawyer, an engineer, a business man and diplomatist. In his training he should study to develop that happy faculty of adaptability which will aid him in talking to the mechanic or laborer on the one hand, and the financier and professional man on the other, in such a way as not to antagonize either party. In his position he will hear the grievances and criticisms of a great number of men. He is practically serving, in a city of 10,000 inhabitants, 10,000 masters, and to be able to steer a clear course through the many shoals in his course requires all the study that a man can put to it. The ideal training for a central station manager is a very hard thing to lay out. Personally I think that the work of construction and operation, with that of the resident engineer, is, perhaps, one of the best trainings. You will note that in this I have ignored the business side of the central station manager's work, but the faculty which is called forth in handling the business end of a central station has to be born in a man and will be developed in the other lines which I have noted, and it will be seen that to be able to cope with the many questions of a semi-technical nature which come up from time to time, a good grounding in construction and design will be of invaluable service.

The training of a staff by the manager is a point which is ignored to a great extent—or if not ignored, is slighted. There is a great temptation for the manager to try to handle all the work and make his staff machines; but the ideal staff is one which is composed of different

men, having totally different temperaments and who may be trained to think along different lines. In the smallest central station it should be possible to have the nucleus of a large force, having certain men trained for the accounting department, certain for the new business work, and others looking after the general office routine and stores department. The staff should be carefully advised and trained to treat all persons, who come to the office, with the greatest courtesy. Your consumers expect to be received in a courteous manner, and oftentimes a short answer, or neglect of some of the little courtesies that can be offered, will be the start of a grievance which will grow out of all proportion to the original cause. One advantage that can be obtained, with little expense, is that of having staff meetings to which are called the heads of the different departments, such as the bookkeeper, the solicitor, the foreman of the line gang and the foreman of the power house or sub-station. These meetings can be arranged for an hour or so every week and an esprit de corps obtained which it is impossible to obtain unless the different men know and understand the difficulties that the others are working against. In this way it will be possible to get that ideal condition striven for by all central stations —"team work." It will also be possible to break down the many prejudices between the different members of the staff.

The meter-readers, who in reality come in closer touch with the consumers than any member of the staff, should be especially trained to be very careful, on entering a house, not to cause any more inconvenience than is necessary, and also, if time permits, should enquire after the details of the operation of lights, irons, etc., and see that everything is working satisfactorily. It is not the scope of this paper to deal with the accounting or bookkeeping of the central station, as this is a department upon which a great deal of time could be put, but it will be found to be a great advantage if the bookkeeper, or accountant, can be turned from a machine into a thinker and trained to see beyond the figures on the books.

A great deal of work can be put in by the central station manager in developing a good distributing system and competent field force. The great tendency in this line of work is to follow the load and not to develop it along previously designed lines. Hence we have the straggling systems which may be seen in many of the towns of Ontario and which, within the next few years, will have to be remodelled. A system should be laid out with a general view to extensions either on the loop system or on the tree system. This will be found, in new plants, to be very easily done, and the remodelling on old plants should be along these lines, as it will be found that a great saving in copper and line-drop will result from it.

To choose the foreman of a line gang is a point that too much time cannot be spent on. To have a man who understands linemen and also understands his work is a great boon to any central station, as this is

the man who is building up your plant and is, in reality, spending your money. It would also be well if the manager could find time to make a regular inspection of his lines and subs to see that everything is in good working condition and is not disfiguring the town or city in which he is located.

Of course, the great object for every central station is to get new business and we are often approached with different schemes of quick campaigns which last from a week to two or three months and for which there is quite a considerable outlay of money. It is the writer's belief that the real results from these campaigns are short-lived, and if it is possible to formulate a general and systematic campaign, which can be carried on by the regular office staff with the addition, perhaps, if it is necessary, of a solicitor, far greater benefits will result therefrom. Such a campaign can be carried on by the use of irons, toasters, utility motors and other household helps which appeal to the modern housewife and also, if it is found advisable, the use of the different lighting systems which are now in vogue. The central station manager will do well, also, to look at the proposition of cooking by electricity. This is by no means a mad dream at the present time, and the gas stove within the next few years will find a very strong rival in the electric stove. There is no doubt about it, the electric stove is cleaner, handier, and more easily regulated. At the present time it is more expensive in first cost, as the production is smaller than the gas stove, but most central stations will find it to their advantage to be able to offer a low rate to consumers who use electric ranges as an auxiliary to their coal ranges, as this is for the most part summer load and off-peak.

Let us look for a few minutes at the origin of the business of the central station as we now see it. Some time previous the central station, or its representatives, has approached the municipal authorities with the idea of obtaining a franchise for running poles, or conduits, on public property, guaranteeing to the town to supply it with electrical energy for lighting and power purposes. In this way we see that in the central station of the present we have two parties entering into a contract and the central station has, as its large silent partner, the public of the municipality. This fact has been ignored, or slighted, in the past to a certain extent, and the public, naturally, has conceived a very exaggerated idea of the wrongs done it by the central station; it almost believes that it has given the greater and larger part of the assets of the partnership to the central station without any benefit reverting to the municipality. But of late years central stations have recognized the fact that the public has its rights and should be considered to a greater extent than it has in the past and we find the modern idea of central station work entirely different from central station ideas and ideals of some ten to fifteen years ago. On the other hand, the public should not close its eyes to the fact that the central

stations, which it is now attacking, or criticizing, did the great pioneer work in electrical development and placing the product on the market. In other enterprises we have patents and copyrights to protect the work of the pioneers, but there is no such thing as a copyright or patent on the work of the modern central station. The experience gained in this line is public property, and the central station has to look to the public for fair treatment without any real legal protection other than the justice of British fair-play. It will certainly be found to be a great advantage to both the central station and the municipality if they can get together on some common ground and work out the fairest proposition for both parties. This can be done, as it is at present being done in certain quarters, by placing the rates and regulations of the central station under an utility or railway commission who see that the municipality is getting fair treatment and also protect the central station from unfair and biased criticism.

This is what I conceive to be the real work of the central station manager: Being a resident of the town, he should try to develop into a real citizen of it, joining the various clubs and Board of Trade, or Chamber of Commerce, and in this way get into touch with the business men and manufacturers and professional men of the town. He will then learn of many things that are on foot and have a chance of rectifying any grievance, whether real or imagined, and will be able to forestall any concerted action against his company. We are very liable to only see the outside world of our town as across the office desk and any central station manager will gain a great benefit to himself and his company if he will work as hard in his dinner-coat, or dress suit, as in his business clothes. In short, let the central station manager aim to become looked upon as a good citizen of the town as well as the representative of a light company.

There is a point that might well be brought up here, for it applies to the central station manager as well as to the whole electrical profession. We are dealing with the youngest profession, and yet a branch of the oldest. The profession of engineering started with the work of the Engineer of the Universe, and the highest dignitary at the Roman councils was Pontibus Magnus, the bridge builder. Yet, where do we find the profession standing in the eyes of the public? It is hardly recognized as a profession, being looked upon more as a trade. Why is this view taken? Simply because the engineer is dealing with mysterious laws of nature which awe the lay mind as much by the nomenclature as by the laws themselves, and in doing this the engineer has been inclined to hold himself in reserve, and when he finds himself misunderstood, and perhaps ridiculed, due to lack of knowledge on the part of his critics, he becomes disgusted with the whole work and retires to his office, or study, resolved to leave public life alone. In this way we find our councils, and legislative bodies, controlled by the professions other than engineering. The engineer owes it to the public and to his

city to take an active interest in public questions, and much more does the central station manager.

He is, by training and by the position which he holds, adapted to the work of advice and suggestion along the lines of advancing the city's health, beauty, safety, and prosperity, and why should he not come forward with help? True, he will be looked upon with suspicion at first, but the result will be that his present critics will be his future admirers, and the electrical profession will then come into the full benefit of being one of the learned profession.

It may be claimed that I am an idealist, but if any central station manager will consider the point he will see that the good of the city, its reputation as a clean, healthy city, and its reputation as being a growing, prosperous manufacturing town will certainly add to the revenue of the central station.

Then, for the electrical profession to come closely in touch with the public will serve in a great degree to nullify the present idea of the mystery of electricity. It is a mystery but its results are not. One does not have to know the many phases of chemistry and the digestive organs to eat a hearty dinner, and so one does not have to know the technique of electricity to gain the benefit of the use of it.

Coming now to the responsibility of the central station manager to the individual consumer. In all cities and towns the manager is called into consultation with regard to the best apparatus to use, and since the consumer has not the technical knowledge or training the advice of the manager is relied upon. In giving this advice the greatest care should be exercised to give entirely unbiased advice. It is altogether likely that the manager has his favorite makes, but no concern makes the best available apparatus in every line, although the salesman may try to convince us they do. Try to aid your consumer to get the best possible lay-out for the money expended, and you will find that a well satisfied consumer will be of invaluable service to you. If you have been a construction man, you will find that you will be able to gain your consumer's confidence far quicker by showing him the way to look after his belts, the right oil to use, and how to keep his motors and apparatus in good working condition, than in sitting in your office, and it will be found that if there are more satisfied consumers and greater confidence is reposed in the manager, fewer criticisms will be directed toward the central station and the larger load will be on the lines.

In closing, let me appeal to the central station managers and the electrical profession in general to broaden out and give to the municipality and to the public in general the benefit of their services as broad-minded citizens. This will be found to be done by other professions, and a great benefit will result to the public in general and to the electrical profession in particular, when the members of that profession will come to look upon it as their duty to take a broad-minded view of the work they owe to the community as a whole.

This is the word that year by year
While in her place engineering is set
Everyone of you men must hear,
And none that hear it dare forget.
This we all with a cheerful mind
Bear through life like a torch in flame
And falling, fling to the host behind.
"PLAY UP, PLAY UP, AND PLAY THE GAME."
Newbolt (Drummond).

DISCUSSION.

The President: You have heard this very excellent paper by Mr. MacLachlan, which contains a great deal of good advice. You can see after reading this paper, if you didn't know it before, that the central station manager must be a man of a great many sides. He has many masters to serve. He has his own company, and the customers, and the public, and he must be a man trained to meet those conditions. I should like to hear some discussion on this paper.

Mr. Marston: I want to comment on one of Mr. MacLachlan's statements in the second paragraph of his paper, where he says: "In his training he should study to develop that happy faculty of adaptability which will aid him in talking to the mechanic or laborer on one hand, and the financier and professional man on the other, in such a way as not to antagonize either party." That strikes me as one of the most important things in a central station manager. Particularly with a man who has a comparatively small plant and does the whole work himself it is very important that he be a good mixer as well as a good operator. For a man to be a good mixer doesn't mean that he has to be born to it. A man can develop into a good mixer just as he can develop into a good operator. None of us were born operators; we had to be trained up to it. Now, Mr. Kelly here doesn't know any more about making wheels go round than I do, but when we want to get anything from the city we send Mr. Kelly over there and we get it. When we want a new cusutomer we send Mr. Kelly out, and he gets him. There are other men in our plant whose business is making the wheels go round and they don't know about anything else. Now, in a small central station it is necessary that one man should combine in himself all these characteristics. I question very seriously whether it is economy for a company to expect to get all these characteristics in one man. It seems to me it is well worth a company's while to spend $1,200 or $1,500 to get a man to look after business. Even in a town of 10,000 or even 8,000, it is worth while to pay for a good mixer who can go out and talk to the customers and make them feel there is something in the company other than making juice and letting the man take care of it after it gets beyond his meter. Over in Glasgow, a city of about a million and a half population, they have one canvasser, and their load

factor over there is about 19 per cent. Now, that one canvasser can't go out and do the business. If they hire more canvassers they could level up their load. The same thing applies to a small plant. If you hire one man who spends his time and gives all his atention to getting after that one branch of the business, I believe it would be a paying proposition.

Colonel Street: There is one clause here in Mr. MacLachlan's paper to which attention should be paid, and that is where he says the meter readers come in closer touch with the consumer than any member of the staff, and should be especially trained, etc. Then he goes on to say that also, as time permits, he should enquire after the operation of lights, irons, etc., and should see that everything is satisfactory. I do not think that a meter reader should have anything to say in the house. I know in my experience the less the meter reader says the better, and our strict instructions are that they shall not speak to the consumer except to answer civil questions. If they are asked about any lights being out of order or anything of that kind he requests the consumer to report to the office. A man from the sales department can deal more intelligently with these matters. In my experience if the meter man is allowed to take up other things it will cause trouble. To deal with the question of irons, and lights, and that sort of thing, you need a man of greater intelligence than you usually get in a meter reader. If a man could do that sort of work he wouldn't be a meter reader. Personally I think it is a great mistake to have a meter reader do anything else than read meter.

Mr. MacLachlan: When speaking of that I was referring more to small towns, where the company is hardly in a financial position to have a man to look after that class of work. To have a man to look after that class of work alone is impossible in small towns, where the only outside man is the meter reader.

Colonel Street: That makes that quite clear. Possibly in the smaller towns the meter man would be more intelligent than you would find them in the larger cities.

Mr. T. H. Wright: In our experience we find that while the meter reader may have the ability to look into complaints of that kind, he would not have the time. The object of the company in employing a meter man is to get the reading monthly, and get them in as quickly as possible, and if he devotes any time to complaints or the selling of apparatus he loses more time than would pay to engage an additional man for that business. Now, I would like to ask Mr. MacLachlan, as it may be of interest to the Association, if he could refer us to any special article dealing with the loop and tree system, referred to on page 4. Referring to the value of the manager of the central station to the public, I may say that in my opinion he must be a general utility man. He must be a good all round man, and it takes years to accom-

plish that. He must get the confidence of the citizens with whom he is doing business from day to day.

Mr. T. F. Kelly: I would like to ask Mr. MacLachlan a question. On the lower part of page 5 and the upper part of page 6 he mentions about the central station and the municipality getting together and fixing rates, and he states at the present time that has been done in certain localities. I would like to ask if he knows of any place in Canada where that has been done? It is certainly a grand suggestion, and it is too bad that this suggestion was not placed before the Ontario Government at the time the Hydro-Electric Commission was formed. If that had been the case, and the suggestion had been acted upon, we would not have had the competition at present in London and Toronto, and which we are likely to have in Hamilton should the people decide to make a contract with the Hydro-Electric Commission. It is too bad the Association has not seen fit to ask the Ontario Government in places where private companies are operating for a commission such as the Ontario Railway and Municipal Board, who would have control of those rates and not compete with private ownership.

Mr. MacLachlan: I was referring more to the Utility Board across the line. I couldn't say as to Canada, but I know of several large companies where their rates are governed by a committee or a board appointed by the Government. I am not at present able to say where it is, but I have heard that is a fact. This Committee or Board has a right to go into the finances of a company and see that the public is getting fair treatment, and also to see that the central station is not subjected to unfair criticism. I understand it has worked very satisfactorily.

Mr. Pratt: I would like to ask if this Commission in turn would protect the company from competition?

Mr. MacLachlan: I haven't any information in that regard, but I know of cases on the other side where the rates have been lowered and cases where the rates have been raised, not by the central station, but by the Board. If they find a company is cutting rates simply to get business, or going wrong in any way, the committee says your financial statement will not warrant that; raise your rates and get on a good financial basis and then you can lower your rates. In that way, from an investors' standpoint, the companies are more sound than they have been in the past, and the public is getting a fairer rate than they could get from any other system.

Mr. Marston: In reference to Mr. Pratt's question as to protecting the companies from competition, I believe there are eleven Public Service Commissions in the United States, and in all cases but one (the State of Vermont) competition is either absolutely forbidden in the Bill creating the Commission or else it is forbidden by inference. In the State of Vermont it is different. A provision was put in saying the Commission should not prevent competition. I understand that was necessary to secure the passing of the Bill. I believe, however, the Com-

mission has used its influence to prevent competition in the State of Vermont as well as elsewhere.

Mr. Moore: In regard to this matter I recall that there was one case brought before the Board where the people in a town tried to lower the rates and they were prevented bcause it was found that the rate was a fair one, and they sustained the company. Another case I recall was that of the Adams Gas Pipe Company, where they found three holding companies were earning dividends out of the lighting company, and they ordered a reduction in the rates.

The President: The next paper is one of very great interest to all central stations, and I will now ask Mr. B. G. McNabb, of the Montreal Light, Heat & Power Company, to read his paper entitled ''Relations of Public Service Companies to the Public.''

THE RELATIONS OF PUBLIC SERVICE COMPANIES WITH THE PUBLIC

B. G. McNabb
Montreal Light, Heat & Power Company.

The name "Public Utilities Corporation" naturally implies being useful and of benefit to the public at large. The central station in any city, no matter how large or small, is in a position to be of genuine benefit to the community which it serves. Its purpose is the manufacturing and selling of electric energy for profit. The profit on the balance sheet at the end of the year is the sum total of the quality of service that has been rendered its consumers. By service, I do not mean only the supplying of electric light or power. While, of course, the constant supply of electric current is the fundamental factor in good service really, it is only a part after all. If a city has confidence enough in a public utility corporation to grant them a long term franchise, thereby placing in their hands an asset of unlimited value, then the central station should consider the spirit in which it is given and administer their affairs as a public trust. It is certainly much better for us to retain the franchise given us by the public by keeping their confidence than by law, as it is only by public confidence that we are able to get a franchise.

The public like courteous treatment, not only from the employees who are required to sell the current, but from every one employed in the concern with whom they come in contact. Some consumers look upon the public utilities corporation as a sort of a monopoly whose sole object is to get as much of their money as possible with the least effort; which policy, as you all know, would be insane to pursue. But why do the public judge us in this way? Is it not that we have to some extent spent too little of our energy in cultivating the good will of our consumers?

If you buy an article from a well regulated commercial house it is almost invariably delivered the same day. If through any chance the consumer is found at fault, immediate attention is given to the complaint and the consumer is not allowed to go away dissatisfied. It is only through their satisfied customers that they are enabled to increase their sales. A public utilities corporation to my mind should conduct its business on similar lines. Our object should be at all times to give the consumer the most we can for his money consistent with good business judgment. We should study closely their requirements and wants, and endeavor to cultivate their good will in every way possible, always bearing in mind that if we are to enjoy their full confidence that we must

play open and above board with them, not part of the time, but all the time. We are dealing with a public that are too keen to the rights they are privileged to enjoy for any company to labor under the delusion that they can be hoodwinked.

If a consumer makes a complaint he is entitled to have a thorough investigation made, and if matters are found wrong they should be followed up until they are made right. No company can afford to neglect the complaints of its consumers, no matter how small. All consumers cannot be entirely pleased all the time; there are always a few who complain no matter how much you do for them.

A properly conducted complaint department can do a great deal toward making satisfied consumers. A great deal of care should be used in selecting the proper employees for this department. The man at the complaint window should be intelligent, tactful and courteous, preferably one who has had experience in remedying complaints. A consumer who desires to make a complaint should not be obliged to stand listening to a number of other complaints, and each complaining consumer should be given every attention and courtesy possible.

Too much attention cannot be paid to the so-called ''crank.'' The fellow who kicks the hardest can, by proper handling, be made to boost just as hard. An instance of this happened in our own company only a short time ago. We had a consumer who was known as a ''crank'' and chronic kicker. He came in one day to register a complaint and advise us that he refused to pay such an exorbitant bill. It seemed as though every bill this consumer had received for the last three months had been high, and, of course, right away he forcibly advised us that he was being robbed, as he termed it. His name and address was taken by a representative with the promise that his complaint would have immediate attention. The representative compared his bills with the previous year and found they were higher; he also had his meter tested and same was found correct. The readings of the meter were compared with the record and they were found correct. Instead of the representative letting the matter drop there and returning the bill to the consumer with the advice that everything was correct, he made a call to the consumer's residence to investigate further, and in conversation with the servants found that some of them burned their light all night long. The next day he phoned the customer and made an appointment with him to meet him at his house the next evening. After going over the results of his investigation with the consumer, he asked him if he would not make a little investigation that evening for himself. The following day we received the consumer's cheque for the full amount of his bill, also a letter thanking us for the treatment he had received from our representative. About two weeks after, this same consumer came over to see me with two other gentlemen, both of whom had just erected large apartment houses and who were considering another system of lighting. This consumer had

found this out from them, as both were personal friends of his. He took it upon himself to talk our service to these gentlemen in such a way that when they came into my office they were practically ready to sign their contract with us. This is only one instance of what can be done with the so-called ''crank'' and only goes to show that the consumer appreciated good service.

We should endeavor at all times to see that orders for service are promptly executed, as great annoyance is often caused the consumer by delays in having service connected. When a consumer signs a contract for electric current he should have his service at least 48 hours after he signs for it, providing, of course, there are no line extensions to make. Nothing will cause a consumer to condemn a company quite so much as delayed service. Often he is just moving into his house and has no other means of illumination or possibly he may have a large force waiting at his factory unable to start until they get power, and if the service is delayed he forms a bad impression of the company right on the start, making it just that much harder to obtain his friendship.

Probably one of the hardest departments in a public utilities corporation to operate properly is its collection department. Their road is a hard one to travel and it requires the utmost skill to collect an overdue account and leave the consumer in a good frame of mind. Often the consumer has a real or imaginary grievance unbeknown to the collector and possibly feels that the bills should not be paid until a further investigation is made. Right here is where the collector should make it a point to find out what the trouble is, and not coldly advise him that if the bill is not paid the service will be disconnected. He should advise the consumer that if the bill is wrong that the matter will have immediate attention and should then see that the complaint is put in the proper hands, where it will be fully investigated. Diplomacy and courtesy are surely appreciated by the consumer in cases of this kind, as an inefficient employee in this department can do more harm in ten minutes toward creating ill-feeling among the public than a company's diplomats can make right in a week. No one department in a company can be responsible for its success. It requires the combined effort of all departments working in harmony.

Our policy towards the consumer should be very clearly defined and should be forcibly impressed upon every employee. The ''we don't have to'' spirit among employees of a public utilities corporation, if allowed to exist, will soon tell upon the earnings of any company.

If we are called upon to extend our lines by the consumer, we should not let him go away with the feeling that we will do it when we get ready, but rather explain to him that if a company is to exist and supply good service that its first duty is to see that any extension of lines it makes is going to be profitable and then have the ground canvassed for him with that idea in mind. If we transact our business at all times above board and the consumer is brought to realize that ex-

tensions cannot be made without a thorough investigation first being made, he certainly is going to be reasonable enough to wait until such time as we can get the desired information.

Discrimination among consumers of the same class for like service is sure to cause no end of dissatisfaction. No man, no matter how rich or poor, likes to think that he has to pay more for a given article than his neighbor, and I am firmly of the opinion that the sooner public utility corporations get down to a schedule of rates which is the same to everybody for the same class of service, the better we are going to be off. Just as soon as we make it easy for the consumer to understand our rates, then we will have done away with a great deal of prejudice, which is caused by lack of knowledge in this connection.

A central station should be interested in the general welfare and development of the community which it serves and should endeavor to be in all respects a part of that community. We should be willing to assist in any public-spirited movement which would benefit the entire municipality. A great deal of good can be done in this connection by participating in the work of local commercial clubs, business men's associations, etc. Organizations of this kind always help to build up a city, and if your service is up to standard, you are surely going to be fully repaid for your efforts in their behalf.

DISCUSSION.

The President: It is quite certain that the operating companies have learned a great deal during the last few years as to the proper treatment of their customers. There was a time when public service companies were perhaps not so considerate of their customers as they now find it good business to be. There is not much difficulty in convincing a manager or a man holding a responsible position in an operating company of the importance and the desirability of the things which Mr. McNabb advocates. There is more difficulty in carrying out your ideas through the minor grades of the service. It is not always possible to get employees to realize the importance of these things and to deal with the public in the way you want them to. I sometimes think that the man at the counter who sells a lamp to a customer, or who takes down his name and address in a case of trouble, is in some respects of as much importance as the general manager, in this sense, that he comes in contact with a great many more customers than any other officer of the company. A very large percentage of the customers know no one in the company except the young man to whom they speak when they come into the office. Now, their opinion of the company and their comments on the company's policy and way of doing business will be influenced more largely by what this young man does and says than by anything else. An odd customer will penetrate into the superintendent's office, or the manager's office, but the majority do not, and yet the company has to be responsible. I should like to hear the

opinions of some of the operators on this paper. It is really worthy of discussion.

Mr. Marston: Mr. Chairman, I do not want it to appear that I am the only one discussing these matters, but it seems to me that the papers at this Convention are so written as to bring out discussion more than any papers I have ever heard read at conventions. I hope you will not misunderstand me when I say the most commendable feature of these papers is their brevity. It enables the members of the Association to have an opportunity of giving thought to the matter and hearing what others have to say on the subject, and this I think is sure to benefit us. The central station industry is the only one in which the men interested in the business can come together and freely, fully and openly discuss the ideas which are brought out, and discuss the improvements which are brought about in the art, without fear of their being used to the disadvantage of the man who brings out the idea. A central station, as a usual thing, has control of a certain territory. They are competing with one another in securing more customers perhaps than another central station in another town, but we are each working for the benefit of all, and the central station industry is the only industry that is broad enough to realize that what is good for one company is going to be good for every company, and the more we interchange our ideas the better it is going to be for the whole industry.

I want to call particular attention to the last paragraph on page 4 of the paper, where it speaks of ''the crank.'' The most important thing in the central station industry is to get the idea out of the public mind that we are robbers. There are lots of people who come around to us in Hamilton, and they say, ''Why, you are fine fellows and we are going to support you in your Hydro fight, but just the same you are getting too much for your juice; we know you are getting too much for it, but we are going to stand by you anyhow.'' Now, that is not the fact. I do not believe there is a central station in the whole Dominion of Canada that is selling current for any more than they can help. Some are selling it for too little. The quicker we impress upon the public the fact that we are conducting a legitimate business, and while we may not have competition in the individual town, we are competing with every central station in the Dominion and we are working for the growth of our town, the sooner the public is going to realize our position in a new light. One gentleman said this morning that they performed a very important function in looking after the health and safety and general welfare of the community. Now, we know that, but does the public know it? We have got to get out and tell the public and show them what we are good for, and show them why a lighting customer is charged a great deal more than the power customer, and still the power customer is more profitable to the central station man than the lighting customer.

Colonel Street: There is just one point that struck me that Mr. McNabb has overlooked in his very excellent paper. He has certainly

covered the ground most thoroughly. The point which I think is overlooked is the telephone. In my opinion the telephone is the cause of more irritation and ill-feeling among customers than anything else. A gruff answer or a short answer will irritate a customer and possibly cause the loss of the service quicker than anything else I know of. Some few years ago there was a very excellent paper read before the National Electric Light Association, entitled ''Tactful Relations with Customers.'' It seems to me if we could have some copies of that paper distributed among our members it would be of great advantage.

The President: There is no question that the telephone operators should be taught the maxim that ''a soft answer turneth away wrath,'' but it is a difficult thing. It might be wise to employ in what is considered the lower branches of the service, such as the boys registering complaints, men with somewhat better education and a higher grade of intelligence. It might be worth while to pay more money in order to get better service in those departments, which are generally considered unimportant. From a certain point of view they are very important indeed.

It only remains for me to thank Mr. McNabb for his very fine paper.

Mr. George Goring: Folowing along in the paragraph on page 4 that Mr. Marston spoke of, where it speaks of the crank, my brother suggests that a crank is not only of use on a motor boat or an automobile, but a crank is sometimes a good instrument whereby to get more business. A crank in a community among your customers might be likened to a bad disease, if allowed to spread it will cause contamination throughout your customers, but I have sometimes found it is good policy to find out what his hobby is and by using a little tact make a friend of him. Recently I came across a case where a crank was trying to do us out of a little business, but we so satisfied him as a customer that we not only held his business, but increased his load. I think it is good policy to get after the crank and win his friendship if possible.

The President: We are indebted to Mr. McNabb for bringing this subject before us, and I hope the paper will be read carefully later on at home, and it will bear good fruit, which will be Mr. McNabb's reward.

The next paper is ''Some Notes on Business Getting,'' but before this paper is read I would like to introduce to you a gentleman who has been kind enough to come a great distance to see us. It is particularly appropriate that he should be here to-day in view of the affiliation that has taken place. I refer to Mr. J. F. Gilchrist, of Chicago, who is the President of the National Electric Light Association.

Mr. Gilchrist on coming forward was greeted with prolonged applause.

Mr. Gilchrist: I assure you it is a great pleasure to be here to-day. This is the first opportunity I have had to visit one of the meetings of your Association, but I know of the good work which you have done. It is particularly pleasant to be here at this time on account of the

relations which have come into existence during the past year between the Association in the United States and this Association in Canada. It seems to me, in our business particularly, and in the age in which we live, it is very desirable to get together frequently, and when we do get together, to put in good earnest work. We are living so rapidly in the electrical business, and the business is so young, that there are practically no text books which are up-to-date, and the only substitute for text books is to get together with your fellows in the business and compare notes with them as to what their experience has been with new ideas or new apparatus in the interval which has preceded the meeting, and in that way learn what is going on and what is newest in the business and what is up-to-date.

Now, if it is a good thing to have a few live friends in the business whom you can go to to consult on the various problems which confront you, it must be a better thing to have a larger circle of friends, and it seems to me it is up to the men in this room and the men in this business on the other side of the Dominion line, and the men in this business in the whole of North America, to get together, compare ideas, learn from each other, gain strength from each other, and help each other to create public opinion in favor of our business; besides this, getting together assists very greatly in broadening our views. I was very much impressed when hearing the papers read this morning with the spirit which ran through them all, indicating that it is high time that we thoroughly appreciate our position as public servants. We are in business to serve the public thoroughly and well. We are in business to make money for the people who have invested their money in the shares of our companies. The most intelligent thing to do, without any question, is to protect that capital and protect this business by surrounding the whole fabric with the good will of the people who dominate and control things on this side of the ocean, and very generally all over the world with this modern civilization. We can broaden ideas as to matters of integrity and honor in running our companies. The ideas that sharp practice is an indication of clevereness have entirely faded away, and people are realizing more fully that honesty is the best policy. I think that feeling should go down to the very extremities of our company organizations. I think we all have had the experience of getting a young man into our business possibly for the purpose of getting business, who in a few days comes in and shows you where he has in some way hoodwinked a customer, and he feels very proud, and thinks he should be patted on the back. Now, we all know that he has made a very short-sighted move. While he may have been loyal to the company and intended to do a good thing, in reality he has made a very great mistake, because he has taken a great chance of making a bitter enemy against the company. We must educate all of our people so they will have sound ideas in such matters. The man who brought me up in business gave me a maxim many years ago which has always stuck in my mind. He said: "I want it to be very easy to beat this

company once, and after that we will look out for ourselves,'' meaning thereby that he wanted the company to deal so openly and fairly with its customers that it would be very easy for them to take an advantage if they were unfair enough to do so, and that sort of spirit will do much to smooth the path of any public service corporation. I think, gentlemen, that is all I have to say to you this morning. I can only repeat that it is the greatest pleasure in the world to be here with you.

The President: Mr. Parker H. Kemble will now read us his paper on ''Some Notes on Business Getting.''

SOME NOTES ON NEW BUSINESS GETTING

By Parker H. Kemble
General Sales Manager Toronto Electric Light Company.

The Chairman of the Committee on Papers has assigned to me the subject of ''New Business.'' This in itself is so beautiful and broad a title as to allow almost anything to be considered under it. Confining ourselves, however, to new business getting, we reduce the area of country covered somewhat and have only to decide from which of the thirty-two points of the compass we shall approach the subject. The question of methods has been taken up in at least a score of papers, in this and the National Electric Light Association, as has also the question of dealing with the public, but to-day the author wishes to touch briefly on the question of selection of business taken.

For the purpose of discussion, new business can be divided into four classes:

Class A.

Absolutely new business. No service on the customer's premises.

Class B.

New business, where the service has been installed for previous customer, but has not been in use for some time, since the present tenant or occupant moved in.

Class C.

Succeeding business, sometimes called re-signs, where as one tenant moves out the other moves in, and which requires no expense on the part of the company, except from the bookkeeping end.

Class D.

Additional business on the premises of existing customers.

Each one of these main classifications can be divided into two divisions: profitable and unprofitable business. Taking them in the above order let us now see how each of the above classes affects the revenue of the company, and what possibilities of classification there lie in each.

Class A.

Leaving out the question of extension of lines, this class of service requires the greatest expense on the part of the company, the next to the greatest amount of work on the part of the solicitor, while the revenue of the company varies from a minus quantity—as represented by a very small use with a large installation—upwards.

Class B.

This represents less expense to the company, the charge being limited to meter installation and lamps supplied; usually requires more work than Class A on the part of the solicitor, based on the fact that

if the customer did not have some good reason for not using service he would have been signed up immediately on occupying the premises. This class of business is subject to the same consideration as to profitable and unprofitable business except that the investment being so much less, business which would not be profitable in Class A is often profitable in Class B.

Class C.

This, as a rule, requires little or no work on the part of the agent, except to go down and take the application. It requires no expenditure on the part of the company, save that due to the change in record, and as regards profit, any business which brings in revenue sufficient to pay the bookkeeping, interest and maintenance, and depreciation is good.

Class D.

This business usually requires on the part of the agent less work than Class A, and more work than Class C. It requires no expense on the part of the company outside of a change in records and occasionally a change in meter, and is invariably entirely profitable to the company, except in the rare case where additional short-hour peak load business only is secured.

This summing up shows us that the only place were selection can be profitably applied, lies in Class A, or the canvassing of entirely new business. This brings us to the point as to whether the facts in the case, which are in this case the prospects of the possible customer, should not be considered in directing active solicitation for new business. Where the solicitor is rated solely by the number of fifty-watt equivalents or by the number of contracts in determining the efficiency of his work, the natural tendency is to put everything on to the lines which can possibly be secured, absolutely regardless of expected revenue or investment cost to the company.

Classification of business as noted above has a certain directive influence, in fact is apt to have a fairly strong influence in directing the efforts of the solicitor towards that class of business which as a whole is most profitable to the company, but still doesn't reach the main point at issue. The exact line between profitable and unprofitable business depends largely on the method of current supplied. Where steam is the basis of generation, flexibility in overload capacity allows certain latitude in the taking on of peak load business. Where power is bought on a maximum demand basis, any business affecting the peak load should be closely examined. Where a substantial revenue sufficient to carry fixed charges and dividends already exists, it seems to the writer as though these following points should be seriously considered: first the classification or rating of salesmen by the volume of business turned in is entirely wrong; second, there should be some direction or supervision of the salesmen as to the character of the business solicited.

A remark is often made concerning a paper that any one can pull down, and that destructive criticism should be changed into constructive criticism by a suggestion of a remedy. The writer would advocate

that the usual division of the territory into salesmen's districts should be coincident with the division of that territory into fiscal districts, and that the work of the salesmen should be judged by the increase or decrease of net revenue, in the districts covered by the men as compared with the previous records.

In regard to the other question as to the course to be pursued in the selective canvass of new business under Class A, it would seem to the writer, that exactly the same laws may be applied as in any manufacturing business, where the product manufactured is intended to be sold. The taking on of any kind of business for the sake of increased business with the idea that an increase in gross income each month, regardless of manufacturing and distribution costs, is an indication of the success of the concern, has usually been followed in ordinary mercantile practice by failure, ending in re-organization or bankruptcy.

The consideration of the marketing of its product from a commercial point of view is with the public service corporation of very recent date, it being but very few years since the entire attention of the company was focussed on the engineering problems of manufacturing the product to be sold. During the last five years, however, the commercial side has been gradually coming into its own, the result being that the refinements of commercial engineering, if I may use that term, applied to all successful manufacturing concerns, are just beginning to be applied to the selling of the manufactured product—electricity.

As competition becomes more keen, or the supervision of public service commissions becomes more strict, the result in either case is to make success dependent on small details, which will improve the ratio between cost and selling price, as the margin between the two becomes less with the lowered price of the product.

In suggesting this guidance of canvassers in the securing of new business along the lines of securing only profitable customers, the educational value of getting service into a customer, even if in very small quantities, with the idea that it will be followed by future extension, is not overlooked, but in very many cases, what is overlooked is that there is no possible chance for a number of customers to expand.

New business is new business, and is the life blood in the progress of a central station, but the careful analysis of the cost of serving customers of different classes in any large company will show that many hundreds of the customers among the smaller companies and many thousands among the larger, are actually costing the company from ten to thirty per cent. more per kilowatt hour delivered than the company receives from the customer.

It is suggested that the expenditure of money for securing profitable revenue can be better made and greater results secured if judicious care in the selection and securing of new business be exercised rather than the expensive and unsatisfactory attempt of turning an unprofitable customer into a profitable one after an expenditure and investment

on the part of the company has been incurred. In other words, care in putting on Class A business will save much expense in trying to put on additional Class D.

In connection with the above it may be germane to consider briefly the relations of the solicitor and the people of the district, of which he has charge.

It is assumed, of course, that the salesman will have a thorough geographical knowledge of his district. By geographical knowledge is meant, not merely the location of streets and trams, as well as the best place for him to get his lunch, but the lay out of his district as regards manufacturing, residential and commercial possibilities, the fitness of his district for particular industries and a good working knowledge of those industries. That is, if a salesman has a large number of sweat shops in the district which he covers, he should familiarize himself with the sweat shop business, whether electricity would help, or whether it would hinder, for it is a greater blunder to approach a special industry with a recommendation for electricity in an impossible place, than it is to omit to bring up or apply facts which might be favorable. A personal acquaintance with Boards of Trade, business men's associations, a certain knowledge of the political situation and who controls or handles the district, is invaluable. Membership in the leading business associations should be paid for by the company, and the meetings should be regularly attended by the agent. The membership, by the way, should stand in the agent's name, not in the company's.

A knowledge of what has happened in one's district is valuable, but a knowledge of what is going to happen, before it has occurred, is still further valuable. The usual ways of asking questions, getting on the right side of the contractors and builders, are all right as far as they go, but a properly cultivated personal business acquaintance throughout the district will result in friendly hints and tips as to possible business, which will enable the salesman to secure greatly increased business for the company. If he is in close touch with the business men in his territory, he can readily obtain information as to credits and financial liabilities, which will be of material assistance to the fiscal department in determining whether it is necessary to request or demand deposits or personal guarantee. An agent also by this means of neighborhood telegraphy should be, and often is, able to forecast coming business troubles and secure prompt action of the collection department, thus avoiding loss to the company in unpaid bills. In other words, the agent's connection with his territory should not be simply one of going out and taking contracts, but should be so intimate and thorough as to be able to look after the interests of the company from all points. As the public becomes better educated it is necessary for the agent to become more technically familiar with his work and to exercise great care in making preliminary statements to the customer as to the capabilities or probable cost of service.

Electricity, as at present placed on the market by the central station, both as regards rates, service and advantages, is so far ahead of other methods, either of power or light, that it is not necessary to over-stretch its good qualities in the effort to make a favorable impression. Inter-communication between the customers is close and quick, and an agent whose statements regarding what he has to sell are closely borne out in practice soon finds that his work is rendered much less arduous as this reputation spreads, than that of the agent who unthinkingly, or possible, thinkingly, exaggerates in order to make sure of landing the customer. Occasionally, possibly often, dealing with facts without over-stretch of imagination, may result in a little more labor in securing the signature of the customer, but it does result in starting a business acquaintance between the customer and company on a square, honest and pleasant footing, and when followed up by the proper care of the customer after he is connected, can easily be made to develop from acquaintance into friendship.

This naturally brings to mind the care of the customer after the signing of the contract. Many companies find it advisable to have an agent call within forty-eight hours, if possible, after service has been connected, to make sure that everything is running smoothly and satisfactory to the customer. This prevents any little ignorance as to use of the service starting dissatisfaction at the beginning of the business intercourse.

While connected loads are, of course, to be valued, still the agent should never hesitate to call the customer's attention to the possible reduction in bills by changes in his outfit, provided those changes will increase the efficiency of the installation. Sooner or later the customer will find out that changes are necessary, and if he receives that information from an outsider the effect is not so good as if the news came from the company's representative and thus emphasized the stand taken by modern, progressive, public service companies that the customer should pay for what he needs, not for what he can be loaded up to take.

Nothing in the above paper should be construed as meaning that any let up should be made in the campaign for new business, but rather that paying results can be better secured by the concentration of effort along the lines of the greatest profit.

DISCUSSION.

The President: Now, gentlemen, we have heard one of the best papers on this particular subject that it has been my pleasure to hear. The paper is full of wisdom and good suggestions. If we were able to arrange it so that every customer could pay exactly in proportion to his value to the company as a source of revenue and expense, then we might be indifferent as to the kind of business that is brought to us. Inasmuch as it has not been possible to do this, and some classes of business must remain more profitable than others, then any practical scheme whereby the better class of business can be secured rather than the

poor must be commended. There are solicitors who fall into some line of work, and meet with but little success in securing business, but never get into anything else. They find it impossible to secure any other kind of business. There is only one way to cure this, it seems to me, and that is to discriminate in the remuneration. A man is going to follow the line of least resistance, and if he can make as much money in securing that business which he finds easy, he is certainly going to do it. Whether that should be a matter of salary of commission, or both, is a thing to be discussed.

Mr. Larmouth: In following up the idea that Mr. Dion has spoken of, it struck me that Mr. Kemble discriminates rather too much in favor of Class A business over Class D, especially in the supplying of power. Now, where you have a fixed charge especially, calculated on the maximum demand called for by the customer, or else on the rate of capacity of the motor, it is all right. A great many companies are basing it on the capacity of the motors, but if you have a customer who is paying on this basis and who has been operating for a year or two years, you know something about the character of his load, and it is of immense value to you to know this in giving another rate for the same class of business or manufacturing. It seems to me when you have that information that you can, by paying special attention to customers who are likely to increase their load in that line of business, get more profitable business by attending to Class D than in some cases to Class A. That is just an idea I had. This paper is extremely interesting and I am not attempting to criticize it, but it struck me you can get business in that way, having that information.

Colonel Street: I would like to ask Mr. Kemble as a professional business getter, how he considers an agent should be paid, whether he should get a salary in proportion to his abilities, or whether he should be paid by salary and commission, or by commission alone. Of course, if a man is paid a commission he is out to get all the business he can without regard as to whether it is profitable or not, and it is a hard thing to refuse a contract when once brought in.

Mr. Martin: I have listened with a great deal of pleasure to the paper by Mr. Kemble, and I think it is worthy of all the praise that has been bestowed or can be bestowed upon it. There are two points in further expansion of its main idea which might be given some attention. I meet a great many men on the commercial side of our industry who have a growing and increasing sense of their importance in the prosperity of the central station. The recognition has come perhaps within the last five years, as Mr. Kemble indicates, but the work of the salesman certainly dates back to a much more remote period than that. The man who gets the business for our plants is essentially the man on the firing line, and his energy and his courage are not yet by any means as fully appreciated as they should be. The scientific development of our industry will not reach its full fruition until we have at least a perfect

co-ordination between the selling and the engineering parts of the business.

One of the complaints which often reaches me is that the man on the firing line, the new business getter, does not receive the full co-operation from the engineering end that he is entitled to; that he may go out and make contracts that are well worth having and signing up, but when it gets to the engineering end somebody falls down, and the salesman is the man who receives the obloquy which does not belong to him. I think in this regard that it is a good thing to have staff meetings of the company, bringing together the different men who are employed in the different branches of the industry, so that they can understand the difficulty that pertains to each branch, but I think this lack of co-ordination between the engineering end and the selling end has not yet been disposed of as satisfactorily as it might be.

In the previous paper by Mr. McNabb, which was certainly meritorious to a high degree, the point was made that there should be no discrimination in rates. Now, here again is a perplexing problem that the new business getter is up against. Probably, if left to his own sweet will, he would give the company as many rates as there are customers, and I have no doubt that in many companies where the rates are not subject to proper regulation or supervision, where there should be 40 or 50 you will find 5,000, and that may be largely due to the eccentricities of the new business getter. It seems to me if we had that which we advocate so much, full publicity as to our rates, we would have a great many less rates to explain and contend with, and the customer would be better satisfied and the business getter's job would be easier, because everybody would know that they stood on the same basis as the other customer and were getting a square deal.

Mr. Marston: It seems to me that every man here must have received some very excellent ideas from Mr. Kemble's paper. The object of our coming here is to get the ideas of other men. One of the best things about the central station industry is that every man feels he is at liberty to adopt the ideas of every other man. I do not believe that it is possible to lay too much stress on the fact that we must get at the business that will level our load. The question of diversity factor has been considered in many conventions from an engineering standpoint, but it has never received consideration from the standpoint of the new business man. It is of the utmost importance to impress upon the new business getter the fact that it is as much to his interest to level up the load curve as it is to the engineering department itself. We must also pay particular attention to the matter of net earnings. The selling of bonds is the test of gross earnings. On the other hand, the payment of dividends and the increase of salary is also dependent on the increase in net earnings. I was asked the other day by a gentleman in Hamilton to spend less time in telling the Hamilton people what we had done for Hamilton, and start on giving some idea of what Hamilton had done for us. I was accused of trying to make out that the Cataract Company

was a charitable institution. It is nothing of the sort. We are out for dividends, and we want to get those dividends out of the public, but we want to get them by giving the people a service which is worth every cent they pay. The business getter, no matter what position he holds in the company, must be impressed with the fact that in order to increase the dividends he must increase the net earnings, and in order to do that he must build up the load curve until it becomes as nearly a straight line as it can possibly be brought.

Mr. Kelly: With regard to Colonel Street's question as to the payment of solicitors, I think it will be of interest to the members to know how we take care of this in Hamilton. At the present time we pay a salary and also a commission based on the net cash receipts received from the customers. On business that is entirely new we pay a small percentage of the net receipts we receive for the first twelve months. For securing a customer in premises where a man has used electric light and moved out, we pay a certain percentage of the net receipts for three months, and on increased business, supposing the solicitor is able to get a contract for some additional amount, we pay a certain percentage of the additional amount received for three months. This seems to work out very satisfactorily from the company's standpoint, and the solicitors are, as I understand, very well satisfied also.

Mr. Kemble: With regard to the remarks of Mr. Larmouth as to the advantages of Class D, I would be the last one to disagree with him as to the importance of getting all the additional business you can from customers, but the point I want to bring out is that if you would only put such customers on your lines as have capacity for additional power, you would be saved a lot of additional work and worry.

With regard to the point brought up by Colonel Street, in answering that question I feel very much as the professor in the college said when a boy asked: "'What is electricity?'' As regards the methods of payment, the ideal method of payment of solicitors, to my mind, would be to get such a man that you could pay him a fixed salary and depend on his honor to do everything for the company that lay in him. Unfortunately, while we may hang up ideals to be reached after, it is not always possible in central station practice to get hold of them. It seems always a doubtful practise to pay a straight commission based on the amount of business secured, as not only will the kind of business be anything that the agent can sign up, but a large part of the agent's time should be devoted to taking care of the existing customers on the line. The rating of a new business department on the splash it creates every month by the amount of new business secured, is a dangerous thing in my mind. The welfare of the existing customer, the keeping him contented, the removal of the little causes of friction, requires a large portion of the solicitor's time, and for that reason I think the straight commission business basis is a very dangerous one indeed. That brings us to the mixed salary and commission. I believe the Baltimore Company is using a system of that kind, and I think also

the Chicago Company is doing likewise, but if I may be permitted for one moment to criticize two such very successful companies, I would say that the continual issuance of supplementary orders changing or modifying the method of commission payment in those companies would seem to indicate that neither of them had as yet reached an absolutely satisfactory solution of the problem. I am perfectly willing to follow in their footsteps and wait until they have developed something which can be put into effect with a smaller company with a fair chance of success. The system of combined salary and commission also means a considerable addition to the cost in the bookkeeping department, and many of the smaller companies have not a sufficient surplus which would warrant them in doing it. Taking all things into consideration, I think I must answer Colonel Street that the payment of a straight salary with possibly a substantial bonus at the end of the year, provided the revenue from the district covered by the solicitor shows a substantial increase, will be the best solution of putting it up to a man's honor to do his work properly, and reward him when he has worked a little extra hard and turned in results to the company.

I always feel very doubtful about adding anything to what Mr. T. C. Martin says, but it occurred to me in listening to him that while the salesmen often complain of the engineering department not working in harmony with them, many salesmen seem to assume that the only use of an engineering department is to get a service in inside of 48 hours, which they do not as a rule do. It seems to me that there is a large field for co-operation between the salesmen and the engineering department. If the salesmen as a whole were more familiar with the difficulties of the work of the engineering department in getting in services I think that possibly much trouble could be saved, as the salesmen could educate the customers to the idea that putting in a service was not a matter of pushing a button and getting current, but that a certain amount of time was needed. They could possibly help by being more careful in getting the full details when securing the order, and in that way could save the engineering department extra trips to get that information. In other words, the working together of the two departments does not depend on the salesman putting in an order and the engineering department putting in the service, but also on the salesman putting the order in in such shape that the engineering department has full information so that they can go ahead. It ought to be theoretically possible for agents to give such details as the service location, service in, meter in, underwriters' certificate in the possession of the owner, or the contractor has applied for it, and details of that kind, so as to avoid the greater part of the preliminary delays for inspection by the Inspection Department.

Mr. Marston's criticisms seem to be mostly in agreement with the facts brought out in my paper. I thoroughly agree with him that the salesmen should study such things as diversity factor and load curve, as

this knowledge would assist them in getting business. I think I have covered Mr. Kelly's remarks.

I thank you most heartily for pitching into the paper as much as you have done.

The President: You will agree with me that this subject has been admirably treated by Mr. Kemble, and it has brought out discussion which will be of value because it leaves with us some thoughts on a definite subject. Personally, while I do not wish to depreciate the honestry or ability or loyalty of the salesmen, I am rather inclined to the opinion that there is no surer way of leading the salesmen into that class of business which will fill up the load curve as a system of remuneration which makes it more profitable for him to do this than to do anything else. A man who has specialized into some other line of work cannot be expected to look at things quite in the same light, and if you want to convince him of the advantages of a certain class of business — and I say this without any reflection on the salesmen whatever — the surest way is to make his remuneration such that it will be profitable to do that which you want him to do.

The next item on the programme is the joint report of the two committees which were appointed and afterwards combined on the matter of meters and meter fees. Mr. Webber is here and he will read the report.

Joint Report of the Meter Committee and the Meter Inspection Committee

COMMITTEES:

A. A. Dion (Chairman).
R. S. Kelsch.
L. R. McCleary.
J. J. Wright.
H. M. Hopper.
R. M. Wilson.

Committee on Meter Inspection.

L. V. Webber (Chairman).
A. B. Lambe.
A. P. Doddridge.
H. S. Baker.
L. W. Pratt.
P. T. Davies.
John Ingram.
C. Rummel.

Committee on Installation, Care and Testing of Meter.

JOINT REPORT OF THE METER COMMITTEE AND THE METER INSPECTION COMMITTEE

To the Members of the Canadian Electrical Association:—

Your Meter Committees have endeavored throughout the year to improve the meter practise in Canada, by bringing about a closer relationship between the meter men of the Central Stations and the Department at Ottawa, who, in fulfilment of their responsibility for the proper administration of the Electricity Act, send their Inspectors throughout the Dominion.

Included is a report by your committee on ''The Canadian System of Governmental Control of Electric Light and Power Service,'' by treatise on ''Testing for Errors in Polyphase Meter Connections,'' by Mr. H. S. Baker, of Niagara Falls; and a short paper, ''Metering Under Two-Rate Contracts as Practised in Montreal,'' by Mr. P. T. Davies, of Montreal.

When the Inland Revenue Report for the year ending March 31st, 1910, was published, showing the revenues and expenditures in connection with the electric meter inspections, your joint committees thought it an opportune time to approach the Inland Revenue Department: Firstly, with a view to the reduction of fees for the testing of electric meters; and, secondly, to make some suggestions as to slight alterations in the Electricity Inspection Act. In the Inland Revenue Report for the year ending March 31st, 1910, the Deputy Minister states that in the near future it may be advisable to further reduce the charges made in connection with the sources of revenue for both the services (gas and electric).

During the period covered by the report mentioned above, there were 49,525 electric meters presented for verification, which cost the Department $18,880.59 to test, for which they received $46,316, making the cost per meter 38 cents, and the revenue received 93½ cents.

A circular was issued by your committees and sent to the Central Stations of Canada to ascertain their ideas in regard to this matter. There were twelve questions asked by your committee in this circular. The replies indicated that on the whole the companies located in the larger cities and towns were medorately well satisfied with the administration of the Act in respect to service, but objections were raised by some of the smaller companies, the infrequency of the inspectors' visits being one cause for complaint. A few minor complaints were

made of a purely local nature, which were submitted to the Chief Electrical Engineer of the Department, Mr. O. Higman, for adjustment.

A meeting of the Meter Committee was called at Ottawa to consider the replies to our circular, and present a request to the Department for a reduction in fees. Some members of the committee were unable to attend, and sent their opinions by letter. At this meeting it was agreed to ask the Department:

1. To reduce the fee charged for testing electric meters on contractors' premises to 50 cents per meter.

2. For provision for testing of meters in situ, on the request of the company or consumer, the cost of the test to be paid for by the party at fault.

Mr. Higman received our deputation cordially, stating that he was always pleased to consider anything that the Association brought to his notice for the improvement of the Electricity Inspection Act. In regard to the proposed reduction of fees and changes in the Act asked for, he promised to take the matter up with the Minister and advise us. We offered to get up a large deputation to see the Minister.

Subsequently our chairman, Mr. A. A. Dion, wrote to Mr. Higman, asking him for a reply to our petition. The following is the letter received in reply, which applies both to "Gas and Electric Services":

Ottawa, Feb. 2nd, 1911.

A. A. Dion, Esq.,

General Superintendent Ottawa Electric Company.

Dear Sir:—

In reply to your letter of the 1st inst., I beg to state that I have been discussing the matter of fees, etc., with the Hon, the Minister, and he is of the opinion that since I have been able to arrange for changes in the regulations to meet the views of the companies, in other respects, there is no reason why I should not arrange also for a reduction of fees.

The net surplus now for both services is $36,283.06, after deducting the sum of $8,850 for the salaries of the laboratory staff, which sum is now paid out of the Civil Government Vote, and is not shown in the gas and electricity accounts. The Minister is willing that reductions shall be made in the combined services to the extent of about one-half of this amount, namely, $18,000.

The improved service that is being gradually brought into operation will further reduce the surplus to an amount that will not be more than sufficient to provide for eventualities.

It is proposed, after consultation with the gas authorities, to make provision for this reduction and bring it into effect on the first day of April next, the beginning of the new fiscal year.

Trusting that this arrangement will be satisfactory to all parties, I remain,

Faithfully yours,

(Signed) O. HIGMAN,

Chief Electrical Engineer.

The contents of this letter were communicated to the various members of the Meter Committees of the Association, and from the answers received it was quite clear that the proposed reduction was not at all satisfactory. The committee felt that they were not asking for anything that would cause the revenue to fall below the cost of the services; that the Government had accumulated profits, amounting to something over a quarter of a million dollars, for which the companies had received no benefits; that during the present year the profits would greatly exceed those of previous years, owing to a larger number of the meters being tested. The committee still pressed their claim that meters of all sizes be tested for a fee of 50 cents. Your committee received the following reply:—

Ottawa, Feb. 16th, 1911.

A. A. Dion, Esq.,

General Superintendent Ottawa Electric Company.

Dear Sir:—

Your letter of the 11th inst, representing the views of your committee on the subject of meter inspection fees, is received.

In reply, I beg to state that in the future, as in the past, I shall endeavor to so administer law as to lessen, if not entirely prevent, any cause of friction between the Department and the Companies, but I may as well be frank with you, and say at once that on this occasion, I shall not be able to support the proposal of your committee for a 50-cent fee to cover all meters, regardless of size and the electrical pressure under which they are used. Such a reduction would cause a very serious deficit in the revenue, and for this reason could not be recommended.

The correspondence on the subject will be laid before the head of the Department, for further consideration; but I would not encourage your committee to hope for anything more than the assurances already given, namely: that such reduction of the fees will be made as will immediately bring about a balance, as nearly as may be, between revenue and expenditure.

Yours very truly,

(Signed) O. HIGMAN,

Chief Electrical Engineer.

In reply to the above your committee expressed themselves as follows:—

Ottawa, Feb. 20th, 1911.

O. Higman, Esq.,

Chief Electrical Engineer.

Dear Sir:—

I have your letter of the 16th inst., in reply to mine of the 11th inst., on the subject of Meter Inspection Fees. You state that you "would not encourage our committee to hope for anything more than the assurances already given, namely, that such a reduction of the fees will be made as will immediately bring about the balance, as nearly as may be, between revenue and expenditure."

I desire to make it quite clear that that is all we ever asked. The difference between your views and our views, as to what the fees should be, arises from our belief that in reserving $18,000 you are allowing for a good deal more than is likely to be spent on necessary improvements for the number of meters tested during the present fiscal year, and we believe that at 50 cents per meter you would still have enough left to carry on the improvements which you have in mind.

You now say that this would cause a very serious deficit. You have the inside information, and while I think that the revenue will increase, perhaps beyond your expectations, I am willing, personally, to let the case rest with you, confident that you will carry out what you have expressed clearly in the last paragraph of your letter, ''that such a reduction of the fees will be made as will immediately bring about a balance, as nearly as may be, between revenue and expenditure.''

Thanking you for your atention to our representations and demands, I am,

Yours very truly,

(Sgd). A. DION,

The Committee is glad to be able to state that they have recently received the official notification of a new schedule of fees, which is as follows:—

AT THE GOVERNMENT HOUSE AT OTTAWA.

Monday, the 29th day of May, 1911.

Present:

HIS EXCELLENCY THE GOVERNOR-GENERAL IN COUNCIL.

His Excellency in Council is pleased to order that the tariff of fees for the verification of electric meters, established by Order in Council of the 21st day of June, 1909, shall be and the same is hereby repealed and the following adopted in lieu thereof from the 1st July, 1911:—

For meters verified at regular testing places:—

Class 1.—Ampere-hour meters of any type or capacity, for use on circuits of any voltage, and two wire watt-hour meters of any capacity, for use on circuits not exceeding 250 volts $0.60

Class 2.—Three wire direct current or three wire single phase watt-hour meters of any capacity, for use on circuits not exceeding 250 volts between outers, and polyphase meters of any capacity for circuits with a maximum potential not exceeding 250 volts .... .75

Class 3.—Meters similar to Classes 1 and 2, but for potentials exceeding 250 volts but not exceeding 650 volts 1.50

Class 4.—Meters similar to Classes 1, 2, and 3, but for potentials exceeding 650 volts (see not (b) 5.00

For meters verified in situ:—

Disputed meters may, at the request of either the purchaser or the contractor, be tested in situ, in which case an additional fee is to be charged of 1.00

(Sgd.) RODOLPHE BOUDREAU,
Clerk of the Privy Council.

The President: I think we ought to be gratified with the work this Committee was able to do for the Association. This Committee took up its work seriously with the intention of getting something. It felt that the Government in making large profits on the inspection of meters was not carrying out the intention of the Act, which was that the service should be merely taxed an amount sufficient to pay for itself. We approached the Department to obtain a 50-cent rate, and we did not get it. We got 60 cents, which was a considerable reduction. The assistant to the chief engineer of the Inland Revenue Department is here this morning, and I have no hesitation in saying in his presence that I do not consider the Government has gone far enough in meeting our demands. I believe we were justified in asking for a 50-cent rate, and the Government could have given it to us without any risk whatever. Mr. Higman said they could reduce it to 60 cents and leave a balance of $18,000 for eventualities. Now, the number of meters increases from year to year, and with this $18,000 we felt there was absolutely no risk in making the rate 50 cents. However, seeing we could not secure that, we accepted what was offered, and we pin our faith for future reductions on the statement made by Mr. Higman, and to which we are going to hold him, that in any case he is going to have the revenue just sufficient to meet the expenses. However, I think it will be gratifying to all the companies to know that something has been obtained.

Following this report is a paper in explanation of the Canadian System of Government Control of Electric Light and Power Service, which is to be read by Mr. A. B. Lambe.

The Canadian System of Governmental Control of Electric Light and Power Service.

In almost all civilized countries it has been found desirable to establish certain laws regarding electric light and power supply, the fundamental units on which the industry is based, and the type and accuracy of the instruments used for measuring electrical quantities, particularly when employed as the means for determining any bills that may be rendered for a supply of electrical energy. In view of this necessity the Canadian Parliament some years ago passed certain statutes on the subject, and these have been amplified and amended from time to time until they form to-day a very complete system of Governmental control of certain features of electric light and power supply. This Canadian system has generally been understood by those who have occasion to come in contact with it to be fairly complete, but probably very few, even among Canadians, realize that it is really one of the most complete and up-to-date that there is in the world. That this is so is evidenced by the fact that the Japanese Government, who not long ago sent a representative on an extensive tour of investigation of the subject, have put into force in that country a system which is almost an exact copy of ours, that the United States laws are based to a certain extent on the Canadian Statutes, and that the English authorities have more than once stated that they prefer our Canadian arrangements to their own.

Briefly stated, the Canadian system consists of a series of Acts establishing:

1. The Legal Electrical Units for Canada.

2. A Central Standards Laboratory, containing either the units themselves, or the necessary apparatus for deriving and maintaining them, also a variety of secondary standards.

3. The regulations under which Electric Light and Power Companies are required to work, such as point of delivery of current, variations in voltage, accuracy of meters, etc.

4. A system of branch Inspectional Offices throughout the Dominion, each equipped with the requisite staff and instruments for the various testings necessary to see that the requirements of the different Acts are being duly carried out.

All the Acts bearing on the subject are Federal Statutes, and therefore uniform throughout the Dominion of Canada. This is a feature of inestimable benefit to everybody concerned, and one that could advantageously be followed further so as to embrace and legalize the rulings of

such matters as Fire Underwriters' requirements, the grounding of secondaries, standard line construction, etc., because when the same requirements are just as applicable to one part of the country as the other, as they are in all of the above matters, it is greatly to the benefit of everybody to have those requirements uniform in every particular.

Together with the above characteristics of uniformity throughout Canada, the other main feature in which our Canadian laws differ from other countries is that they require the testing and sealing, by a governmental inspector, of every individual service watt hour or ampere hour meter, providing that its readings are used as the basis on which to render a bill. In this requirement of individual sealing the Canadian system differs materially, for instance, from that maintained in England, where the Government Inspectors simply go round and test at random, or from that of the United States, where the various Public Utility Commissions, where such have been established, test only at the request of either the consumer or the company, though requiring the latter to furnish monthly sworn statements of all tests made by their officials. As opposed to these intermittent tests the Canadian system gives continuous protection to each and every company and consumer, and as a consequence produces a feeling of confidence in a company's operations in general, and its meters in particular, which is without doubt of the greatest value to all public service corporations. Besides the testing of meters, the Statutes provide for the testing of lighting voltages, also the frequency, if the system be alternating.

The fundamental standard electrical units for Canada, which are the same as the majority of European countries, and as the United States, are designated as follows, the Act being chapter 53 of the Revised Statutes of 1906:

Electrical Units for Canada.

1. This Act may be cited as the Electrical Units Act, 57-58 V., c. 38, s. 1.

2. The units of electrical measure for Canada shall be the following:

(a) As a unit of resistance, the ohm, which is based upon the ohm equal to 10^9 units of resistance of the centimetre-gramme-second system of electro-magnetic units, and is represented by the resistance offered to an unvarying electric current by a column of mercury, at the temperature of melting ice 14.4521 grammes in mass, of a constant cross-sectional area and of the length of 106.3 centimetres;

(b) As a unit of current, the ampere, which is one-tenth of the unit of current of the centimetre-gramme-second system of electro-magnetic units, and is represented sufficiently well for practical use by the unvarying current which, when passed through a solution of nitrate of silver in water, and in accordance with the specification contained in schedule one to this Act, deposits silver at the rate of 0.001118 of a gramme per second;

(c) As a unit of electro-motive force, the volt, which is the electromotive force that, steadily applied to a conductor whose resistance is one ohm, will produce a current of one ampere, and which is represented sufficiently well for practical use by 1000/1434 of the electromotive force between the poles or electrodes of the voltaic cell known as Clark's cell, at a temperature of 15 deg. centigrade and prepared in accordance with the specification contained in schedule two of this Act;

(d) As a unit of quantity, the coulomb, which is the quantity of electricity transferred by a current of one ampere in one second;

(e) As a unit of capacity, the farad, which is the capacity of a condenser charged to a potential of one volt by one coulomb;

(f) As a unit of work, the joule, which is equal to 10^7 units of work in the centimetre-gramme-second system, and is represented sufficiently well for practical use by the energy expended in one second by one ampere in one ohm;

(g) As a unit of power, the watt, which is equal to 10^7 units of power in the centimetre-gramme-second system, and is represented sufficiently well for practical use by the work done at the rate of one joule per second;

(h) As the unit of induction, the henry, which is the induction in a circuit when the electro-motive force induced in that circuit is one volt, while the inducing current varies at the rate of one ampere per second. 57-58 V., c. 38, s. 2.

3. The units of electrical measure described in this Act, or such standard apparatus as is necessary to produce them, shall be deposited in the Department of Inland Revenue and shall form part of the system of standards of measure and weight established by the Weights and Measures Act. 57-58 V., c. 38, s. 3.

The Electrical Standards Laboratory, situated, of course, at Ottawa, is the repository for the above units, or the apparatus for producing them, as designated in section 3 of the above Act. In it is contained a full equipment of primary standards, these forming the only legal basis for electrical measurements in Canada, and in addition there is a large number of the best laboratory standards that can be obtained, such as Kelvin balances, electrostatic voltmeters, Weston laboratory instruments, photometers, potentiometers, etc. Besides this large equipment of high class instruments, there is the usual laboratory arrangement of storage batteries, alternating current, motor-driven generators, etc., so that very steady a.c. and d.c. voltages of different values can be readily obtained, as can large d.c. currents, the main battery, for instance, having a capacity of 3,000 amperes. Charging is accomplished in the usual way by motor-generator sets, operated from the Ottawa Electric Company's circuits. Besides these charging sets there is a variable speed equipment from which can be obtained any desired commercial frequency. Another feature of the Laboratory is an instrument repair shop, equipped with full facilities for the repair of all ordinary

electrical instruments, combined, of course, with the checking of their accuracy.

Besides being the repository for Canadian standards, the Laboratory inspects and checks the instruments of the various branch inspection offices, which are sent to Ottawa at intervals for that purpose. Further, the Laboratory is prepared to check the calibration of instruments, watt-hour meters, etc., for any outside company. This point should be particularly noted by all companies engaged in the Canadian electrical trade, and by consulting engineers, etc., because it might be questionable whether contracts in which electrical quantities were a deciding feature could be enforced unless it were shown that the instruments used in the readings were in agreement with the legal Canadian standards. The fees for checking the accuracy of various instruments are very reasonable, as will be seen upon an inspection of the following schedule.

1. The Department is now prepared to receive electrical instruments for examination or testing at its Electrical Standardization Laboratory at Ottawa.

2. All instruments submitted to the Department for comparison or standardization must be accompanied by a form of application which can be obtained from the Laboratory or from Inspectors of Electricity. The particulars as to the test required should be carefully specified on the application form.

3. Instruments will not be received which are not plainly marked with the name of the manufacturer and an identification number.

4. Every instrument submitted must be provided with suitable terminals or leads, so that it can readily be connected to the testing circuit without soldering.

5. All indicating instruments must have their dials plainly marked by a suitable scale calibrated in electrical units showing their capacity or range.

6. The Department or the officers of the Laboratory will not be responsible for any damage to instruments either in transport or while at the Laboratory, nor for any loss sustained in consequence of the time that may elapse before the instrument is returned.

7. The Laboratory charges on any instrument according to the subjoined tariff of fees may be paid by marked cheque, postal or express money order made payable to the Chief Electrical Engineer, Inland Revenue Department, Ottawa. Instruments will not be returned nor will a certificate of test be issued until the fees have been paid. Express charges on instruments sent to the Laboratory must be prepaid.

Tariff of Fees.

1. For an instrument intended to be used as sub-standard for special examination and testing $15.00

If required to be kept under observation for a period longer than one month, for each additional month or part thereof	5.00
2. For ordinary direct reading instruments:	
Voltmeter for continuous current only:	
Not exceeding 200 volts	1.25
Exceeding 200 volts and not exceeding 500	1.50
Exceeding 500 volts	2.00
Voltmeter for alternating pressure only:	
Not exceeding 200 volts	1.25
Exceeding 200 and not exceeding 2,000 volts	1.75
Exceeding 2,000 volts	2.50
Voltmeter for both continuous and alternating pressures or for alternating at two frequencies:	
Not exceeding 2,000 volts	2.50
Ammeter for continuous current only:	
Not exceeding 200 amperes	1.25
Exceeding 200 and not exceeding 500 amperes	1.75
Exceeding 500 and not exceeding 1,000 amperes	2.50
Exceeding 1,000 and not exceeding 2,500 amperes	3.75
Ammeter for both alternating and continuous currents:	
Not exceeding 500 amperes	1.75
Exceeding 500 amperes	2.50
Ammeter for both alterating and continuous currents:	
Not exceeding 500 amperes	2.50
Wattmeter for continuous current:	
Not exceeding 200 volts or 200 amperes	2.00
Exceeding these limits up to 2,000 volts or 2,500 amperes	3.75
Wattmeter, alternating current:	
Not exceeding 200 volts and 100 amperes	1.50
Exceeding these limits	5.00
In the case of any direct reading instrument if arranged to record, and if the accuracy of such record is required to be verified: Extra fee for every record verified	.75
3. For determining the constants of integrating meters:	
Quantity Meter, continuous current only:	
Up to a maximum rate of 25 amperes	2.50
Exceeding 25 and not exceeding 100 amperes	3.75
Exceeding 100 and not exceeding 500 amperes	5.00
Exceeding 500 amperes	7.50
Quantity Meter, alternating current:	
Up to a maximum of 25 amperes	2.50
If to be tested at two frequencies, or at one frequency and with continuous current	3.75
Exceeding 25 and not exceeding 100 amperes at one frequency of alteration	3.75

If to be tested at two frequencies or at one frequency and with continuous current	7.50
Exceeding 100 and not exceeding 500 amperes if tested at one frequency	5.00
If to be tested at two frequencies or at one frequency and with continuous current	7.50
Energy Meter, continuous current only:	
Up to a maximum rate of 10,000 watts	3.75
Exceeding 10,000 and not exceeding 50,000 watts	5.00
Exceeding 50,000 watts	7.50
Energy Meter, alternating current:	
Up to a maximum rate of 20,000 watts, if to be tested at one frequency	5.00
If to be tested at two frequencies, or with continuous current	7.50
Exceeding 20,000 watts:	
If to be tested at one frequency	7.50
If to be tested at two frequencies, or at one frequency and with continuous current	10.00
4. For testing resistances and Standard cells:	
For a resistance coil of not less than 1 ohm resistance to accuracy of 0.1%	1.25
For a resistance coil of resistance between 1 ohm and 1/000 ohm to an accuracy of 0.1%	1.25
For a box of resistance coils with wheatstone bridge to an accuracy of 0.1% per coil tested	.10
With a minimum charge of	1.00
For a coil of standard form to highest accuracy obtainable at one temperature	2.50
For determining the E. M. F. of a Weston or Clark standard cell at one temperature	1.25
For testing resistances and standard cells at two different and stated temperatures, the fee to be charged will be double that specified above.	
5. For testing the candle power and energy consumption of incandescent lamps:	
For sample lots of six lamps or less	1.00
For sample lots exceeding six lamps, each lamp	.15
For testing standard incandescent lamps used as standards in photometer work, each	.50
6. For a conductivity test of a sample of copper or other wire	2.50

7. Adjustments to zero will be made on instruments when necessary, but structural repairs can not be undertaken. A calibration curve of the reading of an instrument will be furnished.

Before a service meter can be admitted to verification in Canada, that is, before it will be tested and sealed by any district inspectional office, samples have to be submitted to the Laboratory for inspection as

to the general design of the instrument and its suitability for use in Canada. The same procedure is necessary if any alteration be made in a meter after it has once been approved by the Department. The following are the regulations governing the procedure to be followed, and the special features required in meters for use in Canada:

REGULATIONS.

Article 1.

1. A specimen meter should be submitted to the Department free of charge.

2. The specimen should be accompanied by a specification describing with reference to drawings and diagrams the construction and action of the meter.

3. If approval be desired for similar meters of a larger size than the sample submitted, the specification should include a full description of the construction and action of such larger sizes, so far as they differ from the specimen.

4. The drawings and diagrams must be on sheets of paper 13 inches long and 8 inches wide (i.e. foolscap size). The reference figures and letters must be bold and distinct, and if necessary, they should be placed outside the drawing and connected with the part referred to by finely dotted lines.

5. In the event of approval being obtained, the specimen meter will be retained by the Department. The person or persons submitting the meter must also provide a typewritten or printed copy of the specifications and two sets of copies of the complete drawings, which shall be retained by the Department. One of the sets of drawings must be on tracing cloth capable of furnishing blue prints, the other may consist of blue prints. In each case the sheets must be of regulation size and each must be marked with the trade name of the meter to which it belongs.

6. The meter shall be submitted to such tests, and shall be kept under observation for such time, as may be deemed necessary, and under such conditions as the Department may from time to time determine.

7. The Department's approval of any particular type of meter is only applicable to meters in precise accord with the specimen and with the specification and drawings relating thereto.

8. When an alteration is proposed to be made in the construction of an approved meter, amended specifications and drawings, and, if necessary, a specimen of the altered meter, must be submitted to the Department, who shall decide whether the alteration may be accepted as an immaterial alteration and hence included within the Department's approval, or whether further experimental test is required.

9. When an alteration in an approved meter is considered by the Department to be a material alteration, it will be necessary to submit the altered meter for approval.

Article II.

General Conditions to be Fulfilled by an Electricity Meter Before the Department's Approval Can be Given.

1. The construction of the meter should be mechanically sound and suitable for the purpose, and should fulfil the following conditions:—

2. Each ampere-hour meter should have the maker's name, serial number and the maximum current in amperes engraved or stamped on the name-plate or dial.

3. Each energy or watt-hour meter must have the maker's number, the maximum current in amperes, the limits of voltage, and if for alternating current circuits, the limits of frequency and the constant of the meter in watt-hours per revolution of the disc engraved or stamped on the name-plate or dial.

4. If required, each meter must have a label showing the temperature at which the meter is correct, and any limitations of use, as for example, for motors, arc lamps, circuits having inductance, etc.

5. *Each energy meter must have, for testing purposes, a one kilowatt dial divided into tenths. The record on all dials should be clearly visible and admit of precise reading, and it is preferable that this record should indicate the amount of supply directly, and should not require to be multiplied or divided by a constant.

6. Access to the working parts of a meter must be effectively prevented by a seal to be affixed by the electricity inspector.

Article III.

The Arrangement of the Meter Electrically Should be Such as to Give a Reasonable Probability of Permanence, and Should also Fulfil the Following Conditions:

1. In energy meters in which the pressure as well as the current affects the record the whole of the resistance in the pressure circuit should be operative, and whether entirely operative or not, it should be so wound and constructed as to adequately lessen the risks of partial short-circuiting and leakage.

2. The connection between the pressure and current circuits in the meter must be made on the supply side of the current terminals, and it should be easily accessible to permit of the separation of pressure and current circuits for testing.

3. The meter should not, under working conditions, make a record when the pressure current alone is acting, nor when the pressure is increased 10 per cent. above the normal.

4. The record must not be affected within practical limits by changes of external temperature, by external magnetic forces, by the proximity of masses of iron or other metal, by vibration of the support, or by dampness of the atmosphere.

5. The insulation between the case of the meter and any main entering it must be reasonably good, and where two or more mains enter a meter the insulation between such mains must not be decreased by the connection to the meter terminals.

Article IV.

The Action of a Meter as a Measuring Instrument Should be Reasonably Accurate and Permanent and the Curve Satisfactory. It Should also Fulfil the Following Conditions:

1. The meter should rapidly follow the variations of current, and a continuously recording principle is better than one in which the record is made intermittently.

2. The constant of an energy meter should not be appreciably affected by variations from the normal pressure not exceeding 10 per cent. above or below.

3. The constant of an alternating current meter should not be appreciably affected by variations in the frequency not exceeding 10 per cent. above or below the normal.

4. Meters should not have an error exceeding 3 per cent. (+or—) at any point from one-tenth load to full load.

The main points in which the foregoing Regulations differ from practice elsewhere are as follows, viz:—

A.—The individual sealing of all meters, of course, necessitates terminal boxes accessible after the main cover has been sealed. This method of construction has therefore been standard with all Canadian makers for years back, as it has with European manufacturers also. In the United States, though quite a large percentage of the meters are made without separate terminal boxes, as, due to the absence of any independent sealing, a great many of the operating Companies consider that one sealing device, embracing the terminals as well as the main body of the meter, is quite sufficient for their purpose.

B.—The requirement of a test dial is new, and yet in another way it is not, because the watt-hour-clock, which was standard in Canada up to three or four years ago, possessed in its lowest or right hand circle a dial which had the values now called for in the test dial. This latter is specified in order to facilitate the testing of the dial, which, properly speaking, should be read or checked in every meter, because no matter how correct may be the setting of the disc, there is always the possibility that a clock of the wrong gear ratio may have been put into the meter. A dial reading is further very valuable in the case of disputed tests, especially on residence meters, where what the consumer really wants to see is not a more or less mystical calculation, but a real reading. Test dials have been standard for years back on English and Continental meters, but are not found on those made of recent years in the United States, though, as referred to above, they were present, in effect, when the watt-hour clock was the standard.

C.—The clause calling for the disc constant to be marked on the dial or name plate, and standardizing the watt-hour as the unit for this

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*New meters presented for verification after 1st July, 1911, not having the test dial required by paragraph 5 above, will be rejected by the inspector.

purpose, is most valuable to all concerned, as it provides the necessary information for testing any meter in a very uniform, permanent, definite, and accessible form. As soon as all meter manufacturers have arranged their product so as to comply with this clause, the use of all such indefinite terms as "full load," and "light load," the employment by some makers of watt-minutes, and by others of watt-seconds, as the denominations of their contents, the pasting of flyers on the back of the meter, etc., etc., will be eliminated.

In this connection the committee suggests that the gear ratios of meters be so arranged as to produce disc constants containing not more than two non-repeating decimals.

D.—Regarding ampere hour meters, these are used to a limited extent in Canada, in which respect our practice differs from that of the United States, where they are used scarcely at all, also from that of England, where they are used quite extensively. In the latter country though it is permissible to equip them with clocks geared and marked to read in kilo-watt hours, it being assumed that the meter will be operated at a specified voltage, a practice that is not allowable in Canada.

In this connection your committee is glad to be able to state that Regulations are now under consideration governing the markings on meter dials, so as to make the various designs more uniform, and thus much more intelligible to the consumer. The Association will be duly notified as soon as a ruling is made.

The following is a list of the meters which have been admitted up to date for use in Canada. Your committee is glad to be able to state that arrangements have been made whereby the Secretary of the Association will in future be notified of any changes or additions that take place, so that the members of the Association can be advised accordingly.

LIST OF METERS ADMITTED FOR VERIFICATION IN CANADA.

Meter	Type	A.C. or D.C.	Maker	Seller	Date
T. R. W.	....	Both	C. G. E. Co.	C. G. E. Co.	Nov. 01
Westinghouse	....	A.C.	W. E. & M. Co.	W. E. & M. Co.	Nov. 01
Scheefer	....	A.C.	Diamond Co.	Diamond Co.	Nov. 01
Stanley	D	A.C.	Stanley Inst. Co.	Stanley Inst. Co.	Nov. 01
Duncan	Amp. Hour	A.C.	Ft. Wayne Co.	Ft. Wayne Co.	Nov. 01
Shallenberger	Amp. Hour	A.C.	W. E. & M. Co.	W. E. & M. Co.	Nov. 01
Bastian	Amp. Hour	D.C.	Bastian Co.	Bastian Co.	Nov. 01
A. E. G. Single Phase	....	A.C.	A. E. G. Co.	Munderloh & Co.	Nov. 01
Cutmann	....	A.C.	Sangamo Co.	Sangamo Co.	Feb. 02
Gowlland	....	A.C.	Gowlland Co.	Gowlland Co.	May 03
Thompson	High torq'e	A.C.	C. G. E. Co.	C. G. E. Co.	Nov. 04
Sangamo	....	D.C.	Sangamo Co.	Sangamo Co.	Mar. 05
Showalter	....	A.C.	West. Elec. Co. of Berlin	West. Electric Co. of Berlin.	May 05
Westinghouse	....	D.C.	C. W. Co.	C. W. Co.	Feb. 06
Prepayment	....	A.C.	Peterboro Meter Co.	Peterboro Meter Co.	Aug. 06
Wathour Meter	CC	A.C.	Peterboro Meter Co.	Peterboro Meter Co.	Aug. 07
Westinghouse Polyphase	C.	A.C.	C. W. Co.	C. W. Co.	July 07
Ferranti	....	A.C.	Ferranti Co.	G. C. Royce.	Oct. 07
Bat	O	A.C.	Bat Electric Co.	Bat Electric Co.	July 08
Westinghouse Prepayment	B	A.C.	C. W. Co.	C. W. Co.	Dec. 08
Siemmens	W 10	A.C.	Siemens Co.	Munderloh & Co.	Feb. 09
Bastian	Amp. Hour	D.C.	Helios Co.	Helios Co.	Apr. 09
Sangamo	F	A.C.	Sangamo Co.	Sangamo Co.	Oct. 09
Sangamo	D	D.C.	Sangamo Co.	Sangamo Co.	Jan. 10
Ferranti Polyphase	Balanced	A.C.	Ferranti Co.	G. C. Royce	Apr. 10
Ferranti Polyphase	Unbalanced	A.C.	Ferranti Co.	G. C. Royce	Apr. 10
Packard	K	A.C.	Packard Co.	Packard Co.	Apr. 10
Bat	R	A.C.	Bat Electric	Bat Electric Co.	Aug. 10
Bergman	BE	A.C.	B. E. W. Co.	Chapman & Walker	Oct. 10
Bergman	BS	A.C.	B. E. W. Co.	Chapman & Walker	Oct. 10
Hamilton	Amp. Hour	D.C.	Ferranti.	G. C. Royce	Nov. 10
Aron	....	A.C.	G. E. Co. of London.	Factory Products	Dec. 10

The testing and sealing of meters intended for actual service use in different parts of Canada are carried out by district offices, about twenty in number, extending from Halifax on the east, to Victoria on the west, and Dawson City on the north. Each office is equipped with a complete line of indicating wattmeters, voltmeters, etc., together with means for obtaining any required load.

In addition to indicating instruments the Department also used a number of rotating standard wattmeters, an instrument that apparently is not appreciated by central stations to the extent that it should be. The committee, therefore, most earnestly recommends it to the consideration of all those who have any considerable number of service meters to test, as by its use one operator will frequently turn out more work than can be produced by two men working with an indicating instrument and a stop watch. Moreover, and this is of greater importance than speed, the results in the former case will be more accurate than in the latter. This is due to the fact that, being an integrating instrument, the rotating standard automatically and accurately takes account of any changes in the load that may occur during a test from any cause, such, for instance, as a change in voltage, thus entirely eliminating their effect on the accuracy of the reading. As opposed to this, the use of an indicating instrument means that any load variations have to be averaged by the eye, really a very unsatisfactory method, besides which, another device, a stop watch, has to be used and read, thus introducing a second possible source of error. These difficulties are all real enough in the testing room, but when it comes to testing in situ they are much accentuated, so that for that work the rotating standard is even more markedly advantageous. Besides all this, the calculation of the accuracy of the meter under test is more simple with the rotating than with the indicating instrument, as in one case four quantities have to be taken into account, viz.: seconds, watts, disc constant, and revolutions, whereas with the integrating standard the product of the revolutions of one meter multiplied by its disc constant, as compared with the similar quantity in the other, gives an instantaneous indication of the accuracy. Your committee therefore feels that this type of instrument should be much more widely used than it is, and is very sure that any member companies who may decide to install it will feel very satisfied with their investment.

The stop watches used by the Department of Inland Revenue for meter testing, all offices being equipped with them in addition to the rotating standard, are of English manufacture, and are equipped with a special marking, consisting of a circle divided into one hundred parts, this in addition to the usual second graduations. This decimal marking is exceedingly handy for at once obtaining the error of a meter which is so loaded as to be correct when it makes a given number of revolutions in sixty seconds, as by its use the percentage error can be read from the combination of the seconds hand and the inner circle at the same

time that the seconds error is being read from the outer circle. It is the design of the Chief Electrical Engineer of the Department.

The Statute which authorizes and details the actual work of inspection is Chapter 14, passed in 1907, being a revision of Chapter 88 of the Victoria Acts, passed in 1894, its provisions being as follows:

Short Title.

1. This Act may be cited as The Electricity Inspection Act, 1907.

Interpretation.

2. In this Act, unless the context otherwise requires,—

(a) ''contractor'' means any person undertaking to furnish electricity to any purchaser for lighting or other purposes;

(b) ''purchaser'' means any person to whom electricity is furnished;

(c) ''meter'' means an electric meter, and include every kind of machine, apparatus, or instrument used for measuring the quantity of electrical energy or pressure furnished to the purchaser;

(d) ''purchaser's terminals'' means the ends of the electric lines or conductors situate upon the purchaser's premises at which the supply of electricity is delivered from the service lines;

(e) ''Department'' means the Department of Inland Revenue;

(f) ''Minister'' means the Minister of Inland Revenue;

(g) ''inspector'' means an inspector appointed under this Act by the Department;

(h) ''frequency'' means the number of complete periods or cycles per second of the alternating current.

Unit of Supply.

3. The commercial unit of supply of electrical energy shall be one thousand watt-hours, or the equivalent thereof in ampere-hours at the stated voltage.

Duties and Rights of Contractors.

4. Before commencing to give a supply of electrical energy to any purchaser for lighting purposes the contractor shall declare, in writing under his hand, to such purchaser the constant pressure, and if from an alternating current source, the frequency, at which he proposes to supply energy at the purchaser's terminals.

2. The variation of pressure, and in the case of alternating currents the frequency, at any purchaser's terminals shall not under any conditions of the supply which the purchaser is entitled to receive, nor at any time, exceed four per cent. from the declared constant pressure or frequency, whether such variation is due to the resistance of the service lines or apparatus belonging to the contractor, or to any action or effect produced by such apparatus, for which the purchaser cannot be shown to be responsible, or partly to a variation of pressure in the distributing mains from which the supply is taken.

5. The contractor shall be responsible for all electric lines, fittings and apparatus, belonging to him or under his control upon the purchaser's premises, being maintained in a proper condition, and in all respects fit for supplying energy; but he shall not be responsible for any damages arising from the use of the electric current in lines, fittings and apparatus not belonging to him or under his control.

6. If the contractor is reasonably satisfied, after making all proper examination by testing or otherwise, that at some part of a circuit a connection with the earth exists of such resistance as to be a source of leakage, and that such connection does not exist at any part of the circuit belonging to the contractor, any officer of the contractor, duly authorized by him in writing, may, for the purpose of discovering whether such connection with the earth exists at any part of the wires upon any purchaser's premises, at all reasonable times, after giving one hour's notice of his intention to do so, enter such premises and disconnect the purchaser's wires from the service lines, and may require the purchaser to permit him to inspect and test the wires and fittings belonging to the purchaser and forming part of the circuit.

7. If, on such inspection and testing, the officer discovers that a connection exists between the purchaser's wires and the earth, and that such connection has an electrical resistance of less than five thousand ohms, or if the purchaser does not give all due facilities for such inspection and testing, the contractor shall forthwith discontinue the supply of energy to his premises, giving immediate notice of such discontinuance to the purchaser, and shall not recommence such supply until he is satisfied that such connection with the earth has been removed.

8. If any purchaser is dissatisfied with the action of the contractor, either as to the mode of making the test or in discontinuing the supply of electricity to his premises, the wires and fittings of such purchaser may, on his application to the Department, be tested, for the existence of such connection with the earth, by an inspector.

9. Any officer of the contractors authorized in writing by the inspector may, for the purpose of,—

(a) Inspecting their electric wires, meters, accumulators, fittings, works, and apparatus for the supply of electricity; or

(b) Ascertaining the quantity of electricity consumed or supplied; or

(c) Removing any electric wires, meters, accumulators, fittings, works and apparatus belonging to the contractors; or

(d) in cases where a supply of electricity is no longer required or the contractors are authorized to take away and cut off the supply of electricity from any premises, doing as little damage thereby as may be; enter at all reasonable times any premises to which electricity is or has been supplied by the contractors.

2. Such officer shall repair all damage caused by such entry, inspection or removal.

20. Before supplying electricity to purchasers, the contractor shall obtain from the department, or from an officer appointed for the purpose, a certificate of registration for every generating plant owned or operated by the contractor in any city, town, village or other municipality, and shall pay the officer issuing such certificate the fees prescribed by the Governor in Council.

2. Such certificate shall expire on the thirty-first day of March in each year, and shall be renewable from year to year.

Inspectors.

11. The Governor in Council may appoint for the purposes of this Act an electrical expert, to be known as the chief electrical engineer, together with such assistants as the head of the Department may from time to time deem necessary. The chief electrical engineer shall, under the direction of the Minister of Inland Revenue, have the custody of the standards and other electrical measuring instruments, and shall have the general supervision and direction of the work of electric inspection throughout Canada.

2. No person shall be appointed to act as inspector or assistant inspector until he has passed a qualifying examination in electricity, such examination to be held by a board of three examiners, composed of the chief electrical engineer of the department, who shall preside, and two electrical experts to be appointed by the Governor in Council. Nothing herein contained shall affect the position or status of any officer appointed prior to the passing of this Act.

3. Graduates in electrical engineering of any university in Canada may be appointed without passing the qualifying examination.

4. No inspector shall be a seller of electricity or electric meters, or be employed by any person supplying electricity or meters.

Meters.

12. The amount of electrical energy supplied by a contractor to any purchaser under this Act, or the electrical quantity contained in such supply, shall, if the purchaser so desires, be ascertained by means of a suitable meter, duly certified in accordance with regulations established under the authority of this Act.

2. Whenever a reading of a meter is taken by the contractor for the purpose of establishing a charge upon the purchaser, the contractor shall cause a duplicate of such reading to be left with the purchaser.

13. No electric meter shall be admitted to verification in Canada until it has received the approval of the Department.

2. No meter shall be fixed for use which has not been verified and stamped as hereinafter provided.

3. No meter, after it has been fixed for use, shall be verified or stamped by any person except by the inspector as herein provided.

14. No meter shall be fixed for use unless it plainly indicates by means of suitable dials the amount of current or energy passing to the purchaser's wires.

2. Every meter fixed for use shall have the maker's number, the maximum current in amperes, the limits of pressure, and, if for alternating currents, the limit of frequency of alterations, legibly stamped or engraved on the case or dial.

15. No meter shall be stamped which is found by the inspector to register quantities varying from the legal standard of electricity more than three per cent. in favor of either the contractor or the purchaser.

16. The verification of each meter shall be attested by affixing or impressing, on some essential part thereof, a stamp or mark of such description and in such manner as is directed by regulations made by the Minister.

17. Within twelve months after the expiration of five years from such verification and stamping, every meter shall again be verified and stamped.

18. No meter duly stamped as aforesaid shall be liable to be reverified or re-stamped within a period of five years from the then last verification or re-verification thereof unless found incorrect under this Act, or requiring re-verification by lapse of time as aforesaid.

2. The purchaser or the contractor may, at any time, at the cost of the party in fault, require the verification of the meter used.

3. In the event of an inspected meter being found, on re-inspection, to vary from the standard, the contractor or the purchaser, as the case may be, shall only be entitled, in estimating any rebate, to the gain or loss, as the case may be, which has taken place during the three months immediately prior to such re-inspection.

19. Every purchaser may own and use, for determining the amount of electrical energy consumed, any meter which has been verified and stamped as aforesaid.

20. In every case the owner shall keep the meter in good repair, and shall be responsible for the due inspection and testing thereof, and, except as herein otherwise provided, shall pay the fee lawfully chargeable for such inspection, and shall be liable for all penalties incurred with respect to such meter.

21. The verification and testing of meters shall be performed in accordance with the provisions of this Act and with such further regulations, not inconsistent therewith, as are made by the Minister.

22. The contractor shall provide electricity and wiring and all other reasonable facilities for testing, free of charge, at such places as are agreed upon between the contractor and the Department.

23. If any dispute arises between the contractor and the purchaser or between the contractor and the inspector, respecting the correctness of such meter, the inspector shall, if required by any person dissatisfied, refer such dispute to the Department for final decision.

2. During the testing of any disputed meter, the contractor or purchaser may be present, by himself or his agent authorized in writing; and twenty-four hours' notice of the test shall be given by the inspector to both the parties interested.

General.

24. The purchaser may at any time, on payment of a fee to be fixed by the Governor in Council, call on an inspector to test the pressure of the electricity supplied by the contractor, and to furnish a certificate thereof.

25. The inspector shall give to either the contractor or the purchaser, or to both, on payment of the proper fee, a certificate stating the result of his test, and the time at which it was made, and at whose instance, and any other particulars he thinks right to insert for the information and guidance of the persons concerned.

2. Such certificate shall be prima facie evidence of the condition of the meter or electrical pressure tested; and when more such certificates than one are issued, the proper fee shall be paid upon each certificate.

26. The contractor shall at all times keep in his office, in a book or books, the names and addresses of purchasers for the time being—which book or books shall be open to the inspector during office hours, and from which he may take such extracts as he thinks fit.

27. The fees for the inspection and testing of purchasers' wires and the testing of lamps and meters and other electrical instruments and appliances, shall be determined from time to time by the Governor in Council and published in The Canada Gazette, and such fees shall be regulated so that they will, as nearly as may be, meet the cost of carrying this Act into effect; and all fees received under this Act shall be accounted for and paid to the Minister of Finance and Receiver-General and in such manner as the Minister directs, and shall form part of the Consolidated Revenue Fund of Canada.

28. The Governor in Council may from time to time direct stamps to be prepared for the purposes of this Act, bearing such device as he thinks proper, and may defray the cost thereof out of any unappropriated moneys forming part of the Consolidated Revenue Fund of Canadda.

2. The device on such stamps shall express the value thereof, that is to say, the sum at which they shall be reckoned in payment of the fees hereby prescribed.

29. Separate accounts shall be kept of all expenditures incurred and of all fees and duties collected and received under the authority of this Act; and a correct statement thereof, up to the thirty-first day of March then last past, shall be yearly laid before Parliament within the first fifteen days of the then next session thereof.

Offences and Penalties.

30. Every contractor who makes default in complying with any requirement, as to supply, of sections 4 to 10, both inclusive, of this Act, shall be liable for every such default to a penalty not exceeding twenty dollars for every day during which such default continues.

31. Every contractor who fails at any time to keep in his office in a book or books the names and addresses of the purchasers using meters for the time being open to an inspector during office hours, from which

the inspector may take such extracts as he thinks fit, shall incur a penalty of fifty dollars.

32. Every person who, except under the authority of this Act, makes, causes or procures to be made, or knowingly acts or assists in making, or who forges or counterfeits, or causes or procures to be forged or counterfeited, or knowingly acts or assists in the forging or counterfeiting any stamp or mark used for the stamping or marking of any meter under this Act, shall incur a penalty not exceeding two hundred dollars and not less than fifty dollars.

2. Every person who knowingly sells, utters or disposes of, lets, lends or exposes for sale, any meter with such forged stamp or mark thereon, shall, for every such offence, incur a penalty not exceeding two hundred dollars and not less than twenty dollars.

3. All meters having on them such forged or counterfeited stamps or marks shall be forfeited and destroyed.

33. Every person who knowingly repairs or alters, or causes to be repaired or altered, or knowingly tampers with or does any other act in relation to any stamped meter or to the wires leading to the meter so as to cause such meter to register wrongly, or who prevents, or refuses lawful access to any meter in his possession or control, or obstructs or hinders any inspection or testing authorized by this Act, shall incur a penalty not exceeding one hundred dollars and not less than fifty dollars, and shall pay the fees for removing and testing, and the expense of purchasing and fixing a new meter.

2. The payment of any such penalty shall not exempt the person paying it from liability to indictment or other proceeding to which he would otherwise be liable, or deprive any other person of the right to recover damages against such person for any loss or injury sustained by such act or default.

34. Every person who knowingly fixes for use, or causes to be fixed for use, any meter, before it has been verified and stamped as herein required, shall incur a penalty of twenty-five dollars for every such unverified or unstamped meter.

35. Every person, other than the inspector, who, when the accuracy of any meter which has been verified and sealed under this Act is in dispute, wilfully breaks or causes to be broken the seal of that meter, shall incur a penalty of twenty-five dollars for every such offence.

2. The contractor, however, after giving the purchaser twenty-four hours' notice, in writing, of his intention so to do, may break the seal of an undisputed meter when it is found necessary to disconnect such meter from the service lines for readjustment or repairs.

36. Every inspector who stamps any meter without duly testing and finding it correct, or who refuses or neglects, without lawful excuse, for three days after being required under the provisions of this Act, to test any meter, or to stamp any meter found correct on being so tested, or who neglects to perform any duty imposed upon him by this Act, or by any regulations made under the authority thereof, shall incur a penalty

not exceeding fifty dollars, and not less than ten dollars, and shall be liable to dismissal from office.

37. Every person, except the inspector as herein provided, who verifies or stamps, or causes to be verified or stamped, or who issues a certificate as to the accuracy or condition of any meter after it has been fixed for use, shall incur a penalty of twenty-five dollars for every meter so verified.

38. Every person who violates any of the provisions of this Act, or of any regulations established under this Act, or who neglects any duty imposed on him by this Act, or by any such regulation, for which violation or neglect no penalty is specially herein provided, shall incur a penalty of not more than one hundred dollars.

Procedure.

39. All penalties imposed by this Act or by any regulations made thereunder shall be recoverable on summary conviction with costs,—

(a) if the penalty does not exceed twenty dollars, before any justice of the peace for the district, county or place in which the offence was committed; and,

(b) if the penalty exceeds twenty dollars, before any two justices of the peace.

2. Such penalties may, if not forthwith paid, be levied by warrant under the hand and seal of the convicting justice or justices, who may award any imprisonment to which the offender is liable.

3. When the offender is a corporation any process or other paper required by Part XV. of The Criminal Code to be served upon the defendant in procedings under that Part may in such case be served upon the mayor, or chief officer of such corporation, or upon the clerk or secretary thereof.

40. No action or prosecution shall be brought against any person for any fine or penalty under this Act, unless it is commenced within six months after the offence is committed.

Regulations.

41. The Governor in Council may establish rules and regulations—

(a) for the testing of electric light lamps for illuminating power;

(b) for instituting tests to determine what style or make of meter shall be used to measure the quantity of electrical energy supplied;

(c) for determining a standard or standards for arc lighting; and

(d) such other regulations, not inconsistent with this Act, as are necessary for giving effect to its provisions and for declaring its true intent and meaning in all cases of doubt.

42. The Electric Light Inspection Act, chapter 88 of the Revised Statutes, 1906, is hereby repealed.

For the carrying out of this Act there is at present a staff of some sixty inspectors, including those, about twenty-five in number, who are especially detailed for the carrying out of the Gas Inspection Act, which is very similar to the electric in its main features. Last year

there passed through the hands of this staff some 55,000 meters, of which about 30,000 were new, the balance being either reverification, interim, oı disputed tests. There are about 400 central station companies in Canada, of which probably over 90 per cent. use the meter system in whole or in part. Only about 20 of these companies have inspection offices in their own cities, so it will be seen that the work of inspecting the balance necessitates considerable travelling on the part of the inspectors.

The committee is glad to be able to call the attention of the members of the Association to the fact that the above Act, as amended, contains a clause calling for an examination of candidates for inspectorships, it now being impossible for any one to be appointed without passing an examination. The chairman of the Board of Examiners, three in number, is Mr. Ormond Higman, the Chief Electrical Engineer of the Department. The following is a typical examination paper:

Examination Paper.

1. Give a statement of ohms law?
. What modification is it necessary to make in applying this law to alternating currents?
3. Give a statement of Lenz's law of induction?
4. What is meant by—
   (a) The power factor of a circuit?
   (b) The temperature coefficient of a conductor?
   (c) The frequency of the current from an A.C. source?
   (d) Mutual induction, self induction?
5. What is meant by—
   (a) Magnetic lines of force?
   (b) Hysteresis losses?
   (c) Eddy losses?
   (d) Permeability of iron?
6. State the law governing the diffusion of light through a given uniform medium and explain how this is taken advantage of in the photometer?
7. State the different types of integrating electric meters with which you are familiar, and briefly describe the principle governing each?
8. The rotating disc of a certain meter makes when correct 25 revolutions in 60 seconds with a load of 500 watts. If the applied load be 480 watts and the revolutions of the disc 26 in 60 seconds, what is the percentage of error with the applied load?
9. On certain indicating voltmeters the divisions of the scale are smaller at either extremity than near the centre of the scale. Give the reason for this and state how an index error of one division, other conditions being normal, would affect a reading near the centre of such a scale?

10. If in a 3-phase circuit operating a 3-phase motor, having a power factor of .89 on each phase, an am-meter in one phase reads 22 amperes and the observed voltage on all the phases is 250 volts, what is the total energy being supplied to the motor?

11. What effect has age on an induction meter?

There are about 150,000 to 200,000 meters in use in Canada, and these are being added to at the rate of 15 per cent. to 20 per cent. per year, which rate of increase will in all probability be maintained for some years to come, if it does not even increase, because the meter system, or some combination of a meter rate and a readiness to serve charge, is becoming more and more recognized as the only proper means of charging for electrical energy. This means that the watt-hour or the curve drawing meter will each year become more and more important both to the consumer and the central station, to the one because they determine the cost of electric light and power, to the other because they largely determine their whole income, in view of which it will be seen that the Governmental system of inspection is of vital importance to everybody connected with the industry, either as buyer or seller. The committee therefore trusts that every central station manager will make himself thoroughly familiar with the various Acts and their operation, and welcomes suggestions for transmission to the Government as to any improvements which can be introduced into the system.

DISCUSSION.

Mr. Lambe: The paper itself goes into matters fairly much in detail, so there is no need for me to take up your time with anything but a few of the main points. First of all, as the President has referred to the matter in his remarks, it is desirable to point out that the surplus from the inspection fees is not in reality as large as it appears to be, in that there is quite a large sum, about $8,000, expended on inspection, which is not charged to that service, though, of course, it should be. Then again, there are a number of extra expenditures which have to be made in this and succeeding years, both for equipment and for salaries, in order to improve the work of the Department. I feel sure that the Association will approve of this policy of improvement, rather than that of letting the service stand still, or go backward.

The paper contains, as you can see, all the Dominion Acts relating to electric light and power undertakings (with the exception of those relating to export), on which the work of the Department is based. Your Committee's report is the first publication, as far as I know, in which all these Acts can be found complete with amendments, and thus thoroughly up to date, and as such it should form a welcome addition to the libraries of all Canadian operating men.

A new point to most of us, I fancy, is the statement that the Canadian system is looked upon with very favorable eyes by such a new

and progressive nation as Japan, and by such an old and thorough nation as England. We ourselves sometimes criticize it, and quite properly too, for criticism is good for all things and all men, but it is nice to know that others think it a desirable one to copy.

The Report gives a short description of the Electrical Standards Laboratory at Ottawa, an institution that should be most valuable to all members of this Association, if you will but use it. It is well equipped, I suppose there is some $20,000 worth of apparatus there, mostly English, and it is open for the testing of almost anything in the electrical line on payment of a comparatively small fee.

[At this point Colonel Street announced that King George V. had just been crowned, and the members arose and gave three cheers for His Majesty, and sang the National Anthem.]

Mr. Lambe (continuing): Two or three other important points that are more or less new are the test dial, which comes into force on the first of next month, the marking of a test constant, which must be in watt-hours per disc revolution, on the name plate or the dial, and the testing in situ of disputed meters. To my mind this latter is a most important matter, and one that will much increase your customer's confidence in all disputed tests. The extra fee of $1.00 which will be charged for testing in situ, does not begin to cover the actual extra cost, but it was put there in order to prevent calls for such tests being made unless for fairly good reason, as people will not pay the extra dollar unless they are really serious and feel that they have a good case.

Another point that I think all consumers will feel interested in is the question of standard marking on meter dials, which the Department is now discussing with the different manufacturers. It will, of course, be of great advantage to everybody to have all dials marked substntially alike. Personally, I think that this idea could advantageously be followed still further so as to embrace the standardization of connections, the direction of rotation, etc.

The above is about all that time will allow me to touch on, but you will see from the Report that our system is fairly complete. Nevertheless, being human, it is not above criticism, and so I want to say to you in closing that if you have any complaints or suggestions, lay them in front of the meeting, the plainer and fuller this is done the better for everybody. If, after discussion, the Association decide to take them up with the Department they will, of course, receive the most careful consideration. There is one point, though, about which I am sure you will all feel pleased, and that is the excellent method we have of appointing Inspectors, namely, by examination. You see that by the Act nobody can be appointed until he has passed an examination, a clause that is of the utmost value to everybody who supplies or who uses electrical energy; you see from the copy of the examination paper, which is printed in the Report, that the examination is fairly stiff; between the two, I think, the Association can feel satisfied that all appointees under the present Act will be well qualified for their various positions, a fact

that should be a source of comfort and congratulation to both the Service and the Association.

The President: We are very much indebted to Mr. Lambe for coming here and helping us in this way. While some criticism has been made, and there has been a difference of views as to what should be done, there are the most cordial feelings between the officers of the Department and the members of the Committee, and the central station managers generally. It should be the aim of this Association to uphold the officers of the Department in so far as we are able. The officers of of the Department are in sympathy with the central stations, and if the Department is given sufficient freedom I think we can get what we want. If there are any grievances of importance it would be a good idea to write about them to the Meter Committee so that these matters can be taken up and arranged.

I will now call upon Mr. Pratt to read the paper by Mr. Davies on "Metering under Two-Rate Contracts as Practised in Montreal."

METERING UNDER TWO-RATE CONTRACTS—AS PRACTISED IN MONTREAL.

By P. T. Davies

The nightly valley in the load curve which represents investment lying idle has led many of the electric companies to endeavor to attract load for this part of the twenty-four hours by offering special rates during these night hours, these rates being often half, or even less than half of the day rate. In the case the rates given depend upon the kilowatt hours used, it is necessary that the consumption may be correctly proportioned between the night and the day meters and some arrangement has to be used to throw the meters in and out of circuit at the contract time daily. There have been many schemes used to accomplish this requirement, most of them depending upon a clock to either throw a switch in the meter circuit or to transfer the driving element of the meter itself from engagement with one dial train to another, set in the same case.

Experience with some of these contrivances has proved that a possibility exists of the clock going out of order and not throwing over at the correct time without it being possible to discover when the error started; again, the clock may stop and it is impossible to tell when this happened. In cases of this kind, there exists one satisfied person, who is certainly not the company's official, but is the wide-awake customer who thoroughly appreciates the fact that for once he has a splendid opportunity of claiming a special rebate, which, needless to say, he gets, while the meter department is given the opportunity of explaining why the apparatus rested.

In one particular case where a flat rate was given in the day from 7 a.m. to 6 p.m., and a meter rate obtained for the balance of the twenty-four hours, a customer regularly claimed rebates, stating that the time clock threw in the meters 10 to 15 minutes early every now and then. In the absence of evidence to the contrary it was impossible to fight the claims, finally when the matter became a nuisance a recording voltmeter was put in to check the operation of the switch, and by this means evidence was made upon which a rebate could be fairly given or witheld. The record proved so useful that it led to a scheme being evolved which takes care of the double or partial meter rate exactly, and which has worked out excellently in every case. The arrangement provides for two meters or sets of meters, one of day and one for night, with the series coils in multiple and the shunt coils controlled by a hand switch, while a time recorder is connected in so that it shows when the shunt circuits of either the day or night meters are energized, thus giving a daily record of the switching operation.

The jaws of he switch are so arranged that the switch blade must make contact with one or the other jaw; if the switch be left in a central position, then both of the meters read. This arrangement protects the company from any possibility of both meters being left off, and also provides a ready means of checking the meters against one another. If preferred, on simple installations, an ordinary four-point snap switch can be used, as same will spring over from one set of contacts to the other and cannot be stopped out of contact.

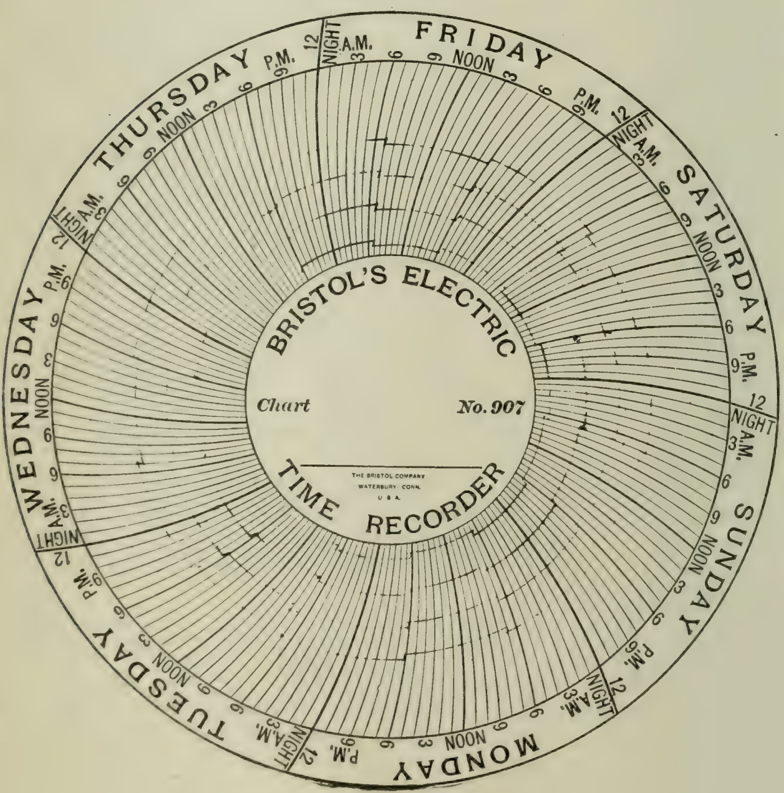


Fig. 1

The time recorder used may be either a recording voltmeter or a simple recorder, which operates when the shunt voltage is thrown upon it; if the customer be connected to the distributing lines at a point where a check on the voltage is useful, the former will provide at least a 12-hour record; if such information be not required, then the latter instrument can be installed at half the cost of a voltmeter. The chart on the time recorder (see fig. 1) can be used for more than one week, as

the pen can be moved across the chart and make a number of different weekly records on the same paper.

Until recently time recorders were only produced for installation on low voltage D.C. circuits, but latterly a type has been designed which can be installed directly on 110-volt A.C. circuits and the operation of same has proven them to be quiet and reliable. With an installation of this kind it is necessary for the customer to throw over the switch. This should be incorporated in the contract as a part of his obligation, thereby releasing the company from all duties except winding the clock and changing the chart.

Fig. 2 represents diagramatically the simplest installation with day and night meters, recorder and hand switch—the most involved installation which the writer has met being two sets of single-phase meters on 3-phase, 10,000 volt power with two sets of single-phase meters on 3-phase, 110-volt lighting, pilot lamps and recorder all being controlled by one double throw switch.

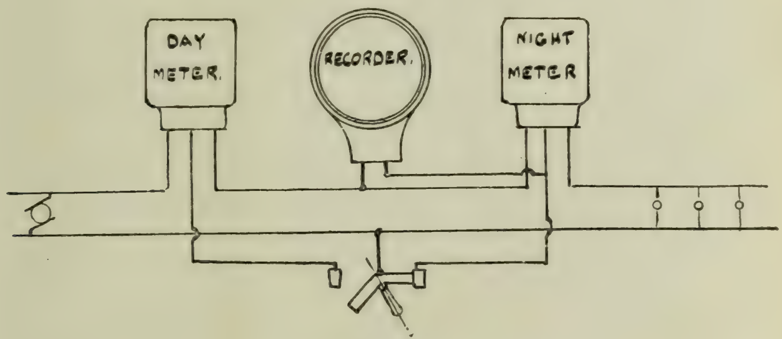


Fig. 2

As previously stated, the usefulness of the record is that it gives a basis on which claims can be equitably settled, and even if the clock on the recorder loses or gains, exact allowance can be made for same, and the case for the company be just as strong.

In conclusion, it might be added that it is well to keep the recorder under lock and key, and to have the chart obscured so that the interests of the company be finally safeguarded.

DISCUSSION.

Mr. Pratt: I am sorry Mr. Davies is not here, as I would have liked to ask him as to his experience with these meters in Montreal. In Hamilton we find on the whole that customers are honorable and willing to carry out their contracts, but five to ten per cent. will run through the off-peak hour if they get a chance. An instrument has been brought out by a Chicago firm which in this connection is very useful. It is known as the Chicago Printing Attachment for watt-hour meters. This

attachment will record in five minute spaces, or any multiple of five minutes up to an hour, the actual current consumed between these intervals, in figures. It is simply necessary to unwind your strip and ascertain the kilowatt hour consumption between any intervals of time as shown by the roll of paper. Another very good method for determining the amount of current at night or during the off-peak hour is by means of the graphic recorder, but that I will not enlarge upon.

The President: While you are thinking of what you are going to say I might supplement Mr. Pratt's remarks regarding the off-peak question. I have as much confidence in human nature perhaps as the average man, and I do not believe that the people of our district are more dishonest than in the rest of Canada, yet after a little experience I am not in favor of the off-peak load unless controlled by some device which will protect the company. A customer is very ready to sign an agreement not to use power during certain hours, and he is quite sincere when he signs it. He means to carry it out, but he is not going to sit up nights thinking about it, and if the company suffers he doesn't feel himself to blame. Our experience is that with the best of intentions people break this rule, and I am not in favor of an off-peak load unless it is profitable enough to justify the company in installing time switches. If there is a time switch under the control of the company or a recording device which will show when the customer breaks the rule, so that we may charge him for that time, it is all right. If a man gets a reduction of 20 per cent. for off-peak load, and he fails to carry out his contract, he ought to pay the whole rate, but that is such a heavy penalty it is impossible to enforce it. That is the trouble, and to my mind the solution lies in dealing with this strictly as a matter of business, not as a matter of trusting each other's honor. Let us put in time switches and let us charge enough to justify us in putting in the switches. I have heard companies telling us at conventions what they were doing, but I have always had the idea that they were deceiving themselves, and a little closer investigation would have shown they were really being imposed upon.

Mr. Lambe: There is just one point, Mr. Chairman, that struck me, where it is stated on the top of page 34, that "it is impossible to tell when this happened." Ordinarily when a clock stops does it not tell you at just what time it did so?

Mr. Pratt: What Mr. Davies meant, I think, was a clock mechanism. In the ordinary case a clock mechanism does not indicate the time.

I might say that in our own company in Hamilton, the Cataract Company, the off-peak power which we sell is confined to customers who use 50 horse power and over, not to the small customers who are hard to keep track of and who are perhaps more prone to violate their contracts than the large customers who look at these matters from a broader standpoint. As a matter of fact, we sell 8,000 horse power in Hamilton on the off-peak basis, which results very materially in levelling up our load curve.

The President: Do you not think, Mr. Pratt, in being ready to sell power off-peak you may thereby lose some of your on-peak ones? A customer might have to take 100 horse power or 200 horse power on the regular rate, if you didn't offer him the other.

Mr. Pratt: I think it is very apt to work out that way, that business which would really be more profitable on the unlimited basis is sold on the limited basis, and it is less profitable, but a customer naturally looks at a big saving in price.

The President: If there is no further discussion, the next paper is by Mr. Baker, on "Testing for Errors in Polyphase Meter Connections."

TESTING FOR ERRORS IN POLYPHASE METER CONNECTIONS

By H. S. Baker

The importance which attaches to the testing of meters is no doubt appreciated by everyone interested, because the revenue of the power company and also the power bill of the customer are dependent upon the accuracy of such tests.

Remarks on single phase watt hour meters will be here omitted, as the testing and installing of single phase meters is comparatively simple.

A common source of error in the metering of polyphase power, is due to incorrect connections of meters and meter transformers into the circuit. These errors sometimes exist for a long time before being discovered.

When polyphase meters are first connected in and started up, it is much more common that the connections are wrong than right, and in most cases it is necessary to exercise the greatest care in order to be **absolutely sure** that the connections are correct, as in many cases of polyphase wattmeter connections, the meter transformer secondary wiring is quite complex. It is easy to be reasonably sure and still be mistaken.

It is almost invariably necessary to make special tests suitable to the particular case in hand, while power is actually being drawn. Generally there is more than one way of taking check readings upon correctness of connections available, and no trouble should be spared in making sufficient tests, and even more than seem to be sufficient to avoid all possible errors in connections and errors in performance of such tests. These errors may be wiring errors due to incorrect diagrams or to errors of wireman, or may be internal to meter transformers or may be intenal to the meter itself.

The inaccuracy of meter indications with incorrect connections is generally dependent upon power factor, and on unbalance of amperes in circuit, and hence cannot be accurately corrected for upon bills which have been made previous to discovery of error, even though the exact nature of the error may be discovered. A three-phase meter incorrectly connected may indicate correctly on 100 per cent., 86.6 per cent. or 50 per cent. power factor, dependent upon what the error of connections is. The indications of meter may be greater or may be less than the true power, depending upon variations in power factor, and depending upon the particular error in hand.

In starting up meters upon polyphase power loads, each case seems to demand a somewhat different system of diagnosis from the last. The

meter wiring is generally concealed in conduits. A number of other instruments are often tied in upon the same polyphase system of series secondary wiring. It may not be possible to short-circuit series transformer secondaries at their transformers in order to separate and ring out the connections. The potential transformer secondary wires where they leave the transformers may not be accessible on account of high voltage. Again, a meter may have to be connected upon an old system of connections, and, of course, no second hand information as to old connections can be accepted as correct.

In view of the above it is thought better to describe a few methods of testing out connections than to prescribe a complete system of test for general application.

Potential transformer secondaries may usually be used to feed test circuits of which one side is grounded, and in general several amperes may be drawn from such secondaries for a few seconds, without risk of doing any damage.

The series secondary system to be tested is generally grounded at some point or may be grounded if desired. Ground one side of potential secondary circuit, and feed from the other side through a bank of lamps to various points on series secondary system and to dead ground. If series secondaries are delivering no current or only slight current then open them up at meter end of circuits. Now if current from lamp bank in flowing to ground, flows through one series secondary, the lamps will be dimmed somewhat on account of the choke coil effect of series secondary winding.

A battery and buzzer feeding through a series transformer secondary winding, acts very differently from when the circuit does not include such secondary. However, as the lamp bank may also be used as a load box for loading meter on speed run, it is generally more available than battery and buzzer. The battery and buzzer are more adapted to wireman's needs than to those of the meter tester. If current from lamp bank passes through two series secondaries, the lamps will be dimmed more than with only one.

Sometimes a short can be placed on a certain series secondary as it leaves the transformer even though it is undesirable to cut open the wiring at that point. Now with current from lamp bank, feeding into a certain wire at meter end of circuit, the lamps brighten upon shorting the secondary of a certain series transformer. This indicates which transformer feeds which wire at meter end of circuit. The shorting of a series secondary may be done by sharp points on the ends of a wire, which may be pierced through the insulation of the series wiring.

If series transformers are delivering enough secondary current to make it undesirable to open the series circuits at the meter, a couple of lamp banks may be connected in at the meter end of the circuits, and fed by current delivered by series transformers. Then a short applied

on one secondary at series transformers, will dim one bank of lamps and indicate which wires are fed from which series transformers.

In the common case of two series transformers, with secondaries connected in V, on three-phase load, with three wires brought to the meter, if one transformer is reversed either in the connections to the circuit, or in internal connections, then the wire from the V. point is the meter will be carrying 73 per cent. more current than either of the others, while if the polarities are all right then all three wires will deliver equal amperes.

In the case of three series transformers connected in star, if one transformer is reversed, there will be a flow of current in the connector, from the star point at the transformers to the star point at the meter, if such connector is installed. If no connector is installed, then there is an open circuit condition upon series secondary system, and dangerous voltages may be encountered on series wiring when one series is reversed.

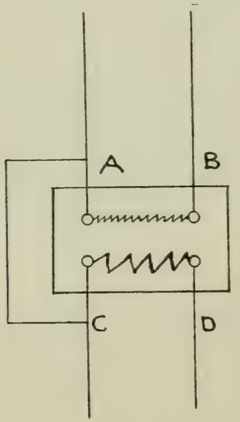


FIG. 1.
POLARITY TEST POTENTIAL TRANS

In the case of three series transformers connected in common delta on secondary side, if one transformer is reversed, then the current from the corners of the delta will not be alike. Two will be alike and the third will be 73 per cent. greater for balanced load on series primaries.

Potential secondary circuits may be easily tested out while alive, by simply applying a lamp between various points at transformers and various points at meters.

The primary connections of meter transformers may generally be traced out by inspection.

Polarity of potential transformers may be determined before installation as follows:

See Fig. 1. Apply a voltage to high side A.B. Connect A. to C.

Now, if voltage B.D. is less than B.A., then the polarity of the transformer is "straight" or "positive." If it is greater, then the polarity is "crossed" or "negative," or "diagonal."

Polarity of series transformers may be checked in the same way as the above, only the winding A.B. is the 5 amp. winding, and a voltage of about 40 should be applied at A.B. by putting lamps in series, on 110 or 220 volts supply.

Polarity of series transformer may also be checked as follows:

See Fig. 2. Feed current through heavy winding and through ammeter. If amperes with D. and C. applied as shown, are less than amperes with D. and C. simply tied together, then polarity is straight or positive.

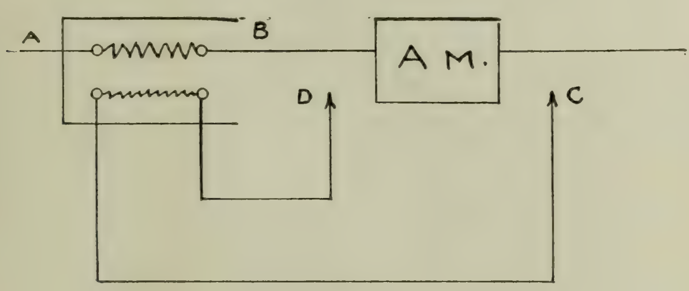


FIG. 2

POLARITY TEST CURRENT TRANS.

Some companies use positive polarity for standard, and some use negative. This leads to trouble in using different makes of meter transformers on same system.

Polarities of wattmeters are immediately observed when connected upon artificial load for calibrating.

A method of test readings which is in itself almost conclusive evidence of correctness on connections, as developed by the writer, will be given, but, of course, it is good policy to supplement the test by some of the above tests where practical.

Polyphase wattmeters (see fig. 3) have two current coils, R. and L., which are reacted upon by two potential coils, r. and l., respectively. The method as applied to three-phase circuits is as follows:

The meter system to be diagnosed has current and potential already upon meter. Consider, for instance, the case of a watt hour type of wattmeter. Open potential circuit l, and leave meter driven by reaction of R., current upon r, potential. The observed speed of the disc

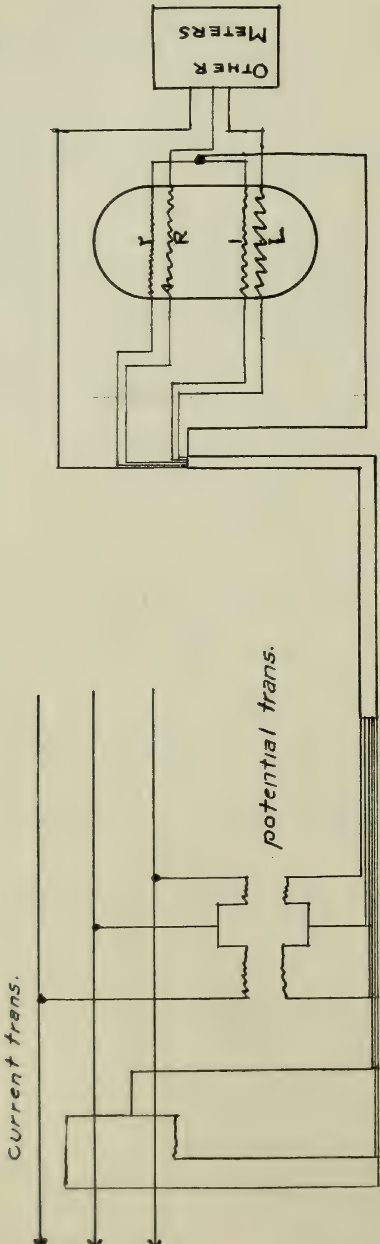


FIG. 3.
METER CIRCUITS

may be designated as R.r. Now close l., and open r., and the reaction is now L.l.

Leave supply r. disconnected but feed this potential coil of meter r. from potential l. This gives reaction of R., current upon l., potential which may be called R.l. Now leave potential supply l. disconnected, but feed potential coil l. of meter from potential supply r. Call the observed speed now L.r.

The following table gives the relative values of these four reactions for various power factors of balanced three-phase load, when meter connections are correct. Total normal meter reaction is R.r.+L.l. =100 per cent.

P.F.		Rr.	Rl.		Lr.		Ll.
100 per cent.	+	50	0		0	+	50
90 per cent.	+	36	—28	+	28	+	64
86.6 per cent.	+	33	—33	+	33	+	67
50 per cent.		0	—100	+	100	+	100
20 per cent.	—	75	—310	+	310	+	175

Fig. 4 is a vector diagram, showing the polyphase potentials, and currents in a three-phase watt meter, for, say 86.6 per cent. lagging power factor, or 30 degrees lag. This diagram illustrates the derivation of the table as follows:

The reaction (in an element of the wattmeter) of the current R. upon the potential r. is measured by the product of R. amperes times r. volts, times the cosine of the time angle between these two vectors, or in other words, the reaction is measured by the projection of R. upon r. (fig. 4). Similarly the values of R.l., L.r. and L.l. are derived.

The converse of this operation is the plotting of the three actual current vectors R., L. and M. of a given case, from the four watt readings taken as described above. This method is described below and applies to balanced or to unbalanced loads, and a current vector diagram of any given case can be easily plotted from the four watt readings and the power factor, etc., calculated from the same.

A rational definition of net power factor in unbalanced, three-phase circuits has been given by Mr. Austin Burt in the transactions of the A.I.E.E., which definition gives a value that will check with the power factor of a number of single-phase loads, drawn in a balanced or unbalanced manner from the three-phase circuit in question. The value of the nett power factor, according to Mr. Burt's definition, may be calculated from the above four watt readings by this formula:

$$\text{Tangent (nett angle of lag} = \frac{(Rr-Ll)-2\,(Rl-Lr).}{\sqrt{3}\,(Rr+Ll).}$$

Of course, these four readings may also be taken upon an indicating or on a graphic wattmeter.

Should there be any error of connections to wattmeter either in transformers, wiring or in meter, it is almost certain to be shown up by

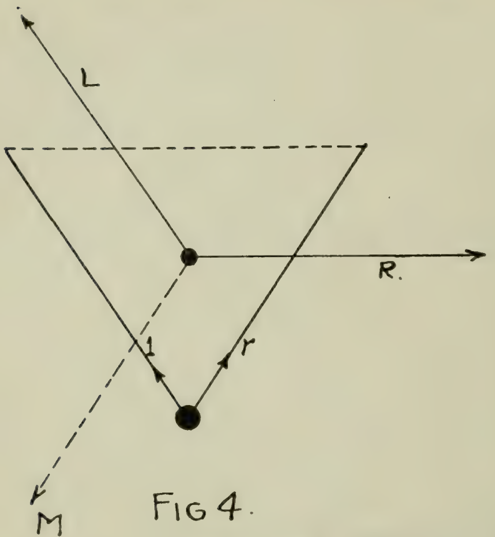


FIG 4.

Current and Potential Vectors.

a serious discrepancy between the proportionality of the four readings taken, and some set of readings in the above table. Of course, if load is somewhat unbalanced there will be a small variation in proportionality even with correct connections, but incorrect connections give results that are extremely different from those given in table.

Polyphase meters are sometimes started up when the only normal load on meter is iron loss of a bank of power transformers. The values of the four readings taken will then generally correspond to a power factor of less than 50 per cent., and either R.r. or L.l. will be found to be negative. It is, however, safer to take the readings under a greater amount of power, because very small readings on wattmeters are apt to be very seriously in error, or in some cases actually opposite in sign to what would be obtained from a perfect meter.

In plotting vector diagrams of the current vectors in order to check meter connections it is sometimes desirable to make a separate check upon the cyclic rotation of the polyphase potentials at the meter. This method consists in connecting an inductive resistance, such as the potential winding of an induction type wattmeter in series with the potential winding of an air core indicating wattmeter, such as a Weston portable. Now feed this potential circuit from potential r., and feed current coil of same air core wattmeter through lamps from potential l., and take reading on meter. Again feed potential circuit from l., and current coil from r., and take reading. If the first reading is less than the second, then the potential l. leads the potential r., as shown in fig. 4, but if the first reading is greater than the second then r. leads l., and the diagram must be considered as rotating to the right, and the cur-

rent vectors as plotted from a set of four watt readings should show reasonable lag behind the potentials of the corresponding wires over neutral.

The behavior of a three-phase wattmeter with incorrect connections is as follows, for a few of the commoner cases of wrong connections:

If the error is that the two outside potentials are interchanged (or that series circuits are interchanged) thus feeding each potential coil from the opposite source, and if load is balanced, then the meter will read zero for any power factor, and on anything but 100 per cent. power factor the opening of one shunt circuit will cause the meter to read either forward or backward. In this case the reactions in the meter are R.l.+L.r., which are equal but opposite in sign for all balanced loads, while the normal reactions should be R.r.+L.l.

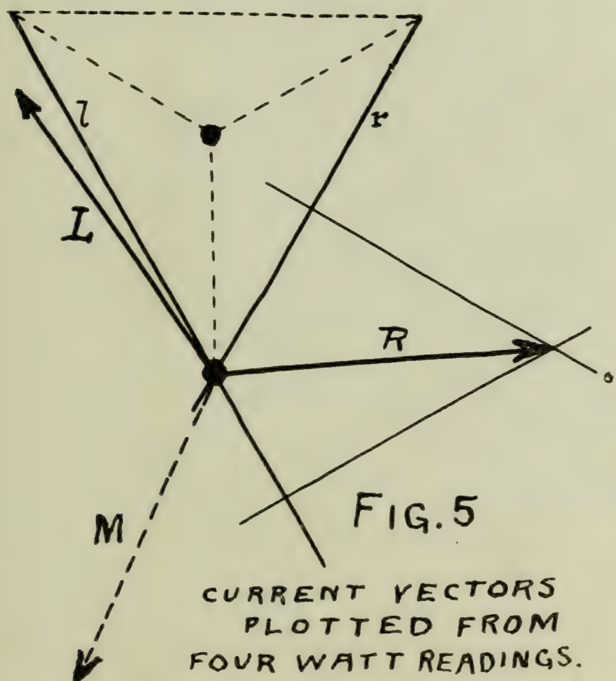


FIG. 5

CURRENT VECTORS PLOTTED FROM FOUR WATT READINGS.

If the error is that one series coil or one potential coil is reversed, then at 100 per cent. p.f. balanced load, the meter stands still, and turns forward or backward upon variation of the power factor. In this case the reaction in meter is R.r.—L.l., which are of equal value at 100 per cent. p.f. balanced load.

The same variations as these are, however, obtained when a potential or current coil is reversed, whether the potential supplies are interchanged or not. In this case the reaction is either R.r.—L.l. or R.l.—L.r., the behaviors of which can be observed from the table.

Other common errors obtained where there are three series transformers installed, and the wrong two are connected to the meter, but in nearly all cases the plotting of current vectors from four watt readings shows presence of an error, and this test, combined with the cyclic order test, is extremely rigid.

The method of plotting the current vectors from the four watt readings will now be described.

Take the case given in table for 90 per cent. power factor.

R.r. = +36, R.l. = −28, L.l. = +64, L.r. = +28.

Lay off angle of 60 degrees (l, o, r.), fig. 5. Measure along o.r. the distance R.r. and erect perpendicular. Measure o. l. distance R.l. (which will be noted is minus)and erect perpendicular.

The intersection of these perpendiculars at R. is the end of current vector O.R., which is current in "R" circuit of wattmeter. Similarly, O.L. is plotted from L.l., and L.r. To get the third current vector, take minus the resultant of these two.

It is hoped that the above condensed outline of some methods of testing for errors of polyphase meter connections may offer some ideas to those interested in the subject of meter installation.

The above report respectfully submitted,

A. A. Dion (Chairman).
R. S. Kelsch.
L. R. McCleary.
J. J. Wright.
H. M. Hopper.
R. M. Wilson.

Committee on Meter Inspection.

L. V. Webber (Chairman).
A. B. Lambe.
A. P. Doddridge.
H. S. Baker.
L. W. Pratt.
P. T. Davies.
John Ingram.
H. C. Rummel.

Committee on Installation, Care and Testing of Meter.

DISCUSSION.

The President: It is regrettable that we could not give a good deal of time to this paper, the preparation of which has involved a great deal of labor. It is one of those papers which can best be appreciated by reading it quietly at home, and I am sure it will be of considerable service to many of us, and Mr. Baker deserves the thanks of the Association for what he has done.

Mr. Lambe: It may be interesting for the Association to know that the Inland Revenue Department is taking up the question of testing all current and potential transformers used in connection with meters, because if you test the instrument only, and not the devices which supply it, you have not really tested the combination by which the consumer is charged. Whilst ordinarily the transformers are fairly accurate, they may have errors in them, and if they have errors at all they are usually pretty large. For instance, I know of a recent disputed bill where the trouble could not be unearthed until they came to test the current transformer, where they found an error of 20 per cent. Regarding the question of polarity, I would like to ask Mr. Baker if he does not think that this should be standardized, arbitrarily if you like, so that all the products of all makers would have the same polarity?

Mr. Baker: That would save considerable inconvenience. In regard to errors in the transformer ratio, there has been a method that seems to be quite satisfactorily developed at the Ontario Power Company for taking the ratio of these transformers. It has been described in the Electrical World, and requires only apparatus that is easily available.

It was moved by Mr. Webber, seconded by Mr. Hicks, that the report of the Meter Committees be adopted.

The President put the motion, which on a vote being taken, was declared carried.

The President: The next item is a paper by Mr. Ralph Beman, of the National Electric Lamp Association, of Cleveland, on ''The Incandescent Lamp and its Circuit.''

THE INCANDESCENT LAMP AND ITS CIRCUIT

By Ralph Beman

National Electric Lamp Association.

Nowadays when a user of electric lamps hears about a new form of lamp he inquires first as to whether it can be operated on his circuit. Circuit characteristics have been so largely standardized that it is almost safe to say that if a new kind of incandescent lamp were developed which for some reason could not be operated on 110 volt, 60 cycle, alternating current, its commercial field would be limited and its success doubtful, even though its efficiency might be high. When we consider the amount of money invested in generating, controlling, distributing and measuring equipment, it is evident that no very radical change in voltage or complicated auxiliary apparatus will be tolerated unless the results amply justify.

This was not always the case. As a matter of historic interest, we may note that the voltage of the first Thompson-Houston alternator was chosen to fit certain lamps which the company had in stock at the time. These were for series multiple operation on constant current circuits, and required about 52 volts, the pressure used for years by the Thompson-Houston Company in residence work.

Granted, however, that the lamp should burn properly on the given circuit, we must admit at the start that though it ''should,'' it often ''can't.''

What I mean is, there are certain factors which place limits beyond which physical and commercial considerations forbid us to go. Did you ever see a tungsten filament lamp taking five watts at 110 volts? Suppose that one were made, how do you think it would work on 25-cycle current? Although in choosing a system of distributing power, the cost and operating characteristics of generators, transformers, converters, etc., would naturally be of first importance, it is reasonable to consider the incandescent lamp and its demands, if a large portion of the power is to be consumed in lighting devices.

In choice between alternating and direct current the incandescent lamp has relatively little to say. Most lamps, as it were, can hardly tell the difference. The facility with which alternating current may be transformed to the desired voltage makes it of great value in the case of electric signs using tungsten filament lamps. There is one lamp, however, that acts very differently on alternating and direct current. That is the lamp having a filament of tantalum.

Without going into the explanation of the phenomena, we may note the accompanying cuts show some of the effects. On alternating current the filament begins at once to divide itself into sections which offset or

get out of line with each other. The higher the efficiency and temperature the easier it seems to be for this action to take place. On direct current the surface of the filament wrinkles up, but does not offset. When a lamp is burned partly on alternating and partly on direct current, its deterioration is less rapid than on alternating current alone. In fact, if the direct current operation comes in the latter part of the life of the lamp, the offsetting becomes less marked, i.e., the filament tends to be restored to its original straightness.

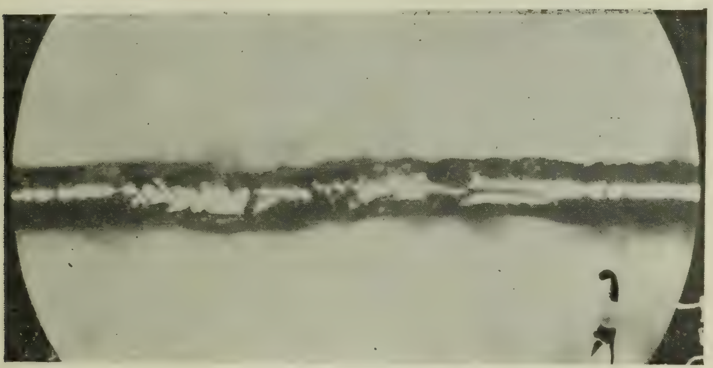


Fig I. Direct Current Operation

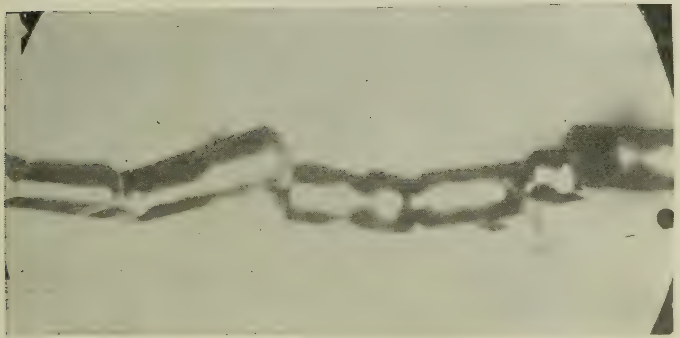


Fig. 2 Alternating Current Operation

Fortunately this strange action need give us little worry as the tantalum lamp is giving place to the higher efficiency tungsten filament lamp whose operating cost is so low that under most circumstances one can afford to use no other lamp.

We have seen that the incandescent lamp will accept either alternating or direct current, and must in general accept the prevailing commercial voltages. The voltage fixed, the range of sizes of the lamp should be large. For each filament material there is fairly definite

minimum wattage for any given voltage. On the other hand, while lamps can be made in very large sizes, the dimensions of the bulb and the total amount of light per lamp are limited by practical considerations. In this country the 500-watt tungsten filament lamp is the largest in general use, although foreign makers have occasion to go as high as 1,000 watts.

As to small sizes, in the carbon lamp we can get down to 10 watts at 110 volts. This means a long fine filament of high resistance material. The use of untreated carbon and the small size of filament make it advisable to operate this lamp at a low efficiency, but that is usually the price we have to pay in getting a small lamp.

With a filament having as low a specific resistance as treated carbon or metallized carbon, the wattage limit is much higher, say 25 to 50 watts.

Coming now to tungsten from which we have learned to expect so much, we immediately see difficulties in making a small lamp. The filament is long and very fine in even the high candle-power lamps, and for small lamps it is correspondingly reduced in size. The accompanying diagram shows the relation of the dimensions of filament of various materials which would give the same candle-power at the same voltage and efficiency.*

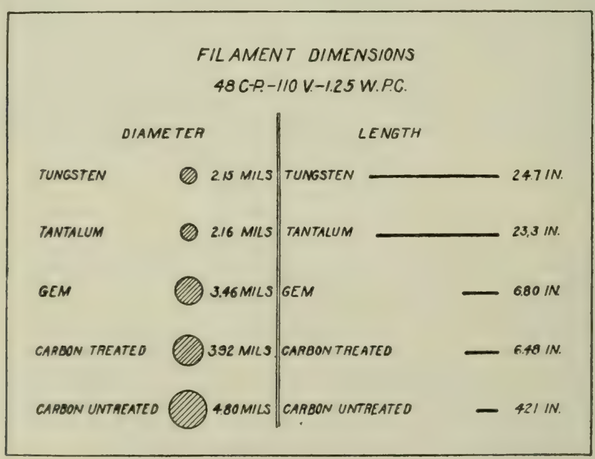


Fig 3

In making the small lamps now on the market tungsten filaments of a diameter of 0.001-inch are used. Filaments as small as 0.0008-inch can be made commercially and in an experimental way filaments as small as 0.00068-inch have been produced. The latter filament is small

*Mr. G. S. Merrill, Journal of the Franklin Institute, April, 1911.

enough to make a lamp of about ten or eleven watts at 110 volts and at 1.25 w.p.c.

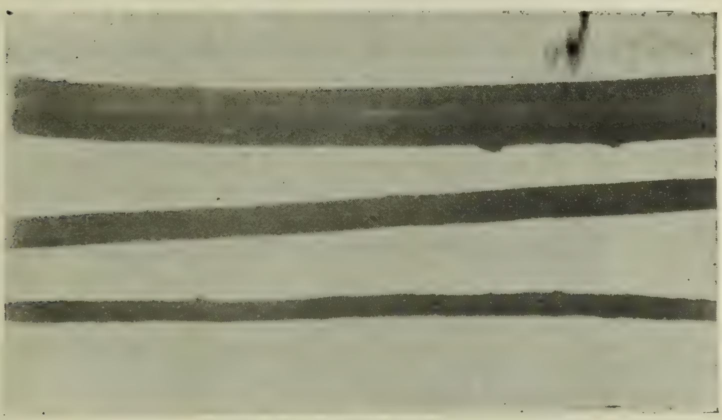


Fig 4

Diameter of hair	0.0026-inch
Diameter of 40-watt filament ...	.0016-inch
Diameter of 25-watt filament ...	.0012-inch

The relative size of a filament and a human hair is shown in the accompanying illustration. The 25-watt filament has diameter less than half that of the hair. The mechanical problem of drawing a wire of very small size is a great one. The dies must be drilled by an expert and finished with extreme care. Errors entirely negligible in larger work make a very decided difference in the area of the filament. If the normal diameter of the die is one mil, and it becomes enlarged even as little as one twenty-thousandth of an inch all around, the area is then over twenty per cent. too large.

Some of the demands for lamps which can be considered only as freaks are rather amusing. One man demands a 500-volt lamp with a close coiled tungsten filament of construction rugged enough to allow use in a street car headlight. Another wants 100 c.-p. at 6 volts. Such a lamp has actually been made, although the current of eighteen amperes required several wires in parallel to carry it through the seal.

So much on the limitations of manufacture of lamps. The question is, if made, will the lamp be satisfactory to the consumer?

It may be too high in first cost.

It may be too fragile.

It may show objectionable flicker under operating conditions.

The first two items are somewhat interdependent. Fragility means breakage in the factory as well as outside and this tends to increase the cost. As has been indicated before, extremely small filaments would cost so much to make that it would be cheaper to use a higher wattage lamp for the given purpose. Where both ruggedness and effi

ciency are demanded we resort to a lower voltage, which means stockier filaments. Automobile lamps at 6 volts or train lighting lamps at 30 and 60 volts, stand the racket even when made of the older style of comparatively brittle tungsten filament.

Coming now to the question of flicker, we need concern ourselves only with 25-cycle current. The lower frequencies such as 15 and 16⅔ when used for single phase traction would doubtless require lamps operating at lower voltages than 110.

Flicker may be defined as the visible variation in brightness of a surface We shall consider only the flicker due to periodic variation in light emitted by an incandescent lamp operated on an alternating current circuit. In order to have this sort of flicker, two conditions must exist.

1. The intensity of light from the illuminant must vary.

2. The resulting variation in illumination must be of such a character as to be noticed by the unaided eye.

One might think that if the candle-power of the lamp varied that it would be noticed at once. That this variation does exist unobserved may be proved by watching an induction motor fan illuminated by small lamps on the same circuit. The lamps themselves do not seem to flicker, but the candle-power changes enough to show the stroboscopic effect; i.e., the fan appears to move backward. Other evidence of variation in candle-power may be obtained by measuring the resistance of the filament, which depends upon the temperature or candle-power, at different times during the cycle. This is found to vary in a regular manner.

By the use of proper apparatus such as a shutter driven by a synchronous motor it is possible to measure the candle-power, also, at different times during the cycle. Data obtained in this way check with those showing variation in resistance.

The accompanying curves indicate the cyclic candle-power variation of a 25-watt tungsten filament when operated at 25, 30 and 60 cycles.

The extent to which the candle-power varies during the cycle depends chiefly upon:—

1. The heat storage capacity of the filament.
2. The frequency of the current.
3. The temperature resistance co-efficient of the filament.
4. The emissivity characteristics of the filament.

If a filament is being fed with energy which comes in puffs, as it were, the tendency will be for the energy to flow out in puffs. But due to the storage of heat we cannot have zero outflow, while we do have periodically zero inflow. That is, while the power reaches zero twice during the cycle the light does not go out absolutely at any time. The larger the filament and consequent storage of heat, the more steady the outflow.

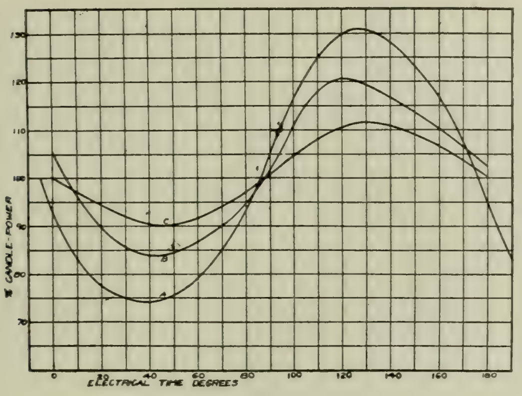


Fig 5.

Cyclic Variation in Candle-Power.
A—25 watts, 114 volts, 25 cycles.
B—25 watts, 114 volts, 30 cycles.
C—25 watts, 114 volts, 60 cycles.

The manner in which the thermal capacity of a filament tends to reduce the fluctuation in temperature (when operating on alternating power supply) may be illustrated by the hydraulic analog of a special reservoir into which water flows at a variable rate. The water put into the reservoir corresponds to the electrical energy put into the filament. The reservoir, we will assume, has a slit in the side through which the water escapes. The water flowing out represents the energy dissipated from the filament by radiation, conduction and convection. Although the rate of inflow may vary over a wide range, the level of the water in the reservoir fluctuates but very little and the rate of outflow remains

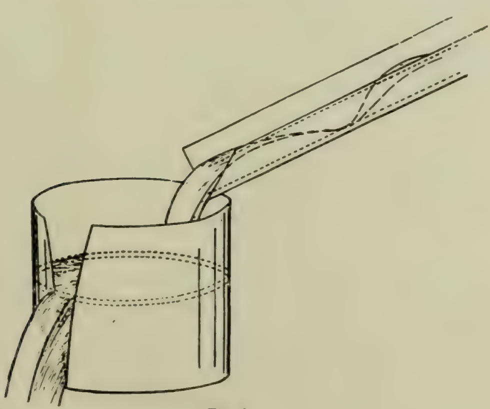


Fig 6

nearly uniform. The greater the diameter of the reservoir, compared with the rate of inflow, and the greater the frequency of the pulsating supply, the less the fluctuation in water level and in outflow. The diameter of the reservoir corresponds to the thermal capacity of the filament and the fluctuation of water level represents fluctuation in filament temperature. In the case of the filament, the greater the thermal capacity and the greater the frequency of the alternating power supply, the less will be the fluctuation in temperature and in candle-power during each cycle.*

A third item affects temperature changes and that is the change in resistance with temperature. Connect two lamps one with a carbon and one with a tungsten filament to the same A.C. supply. The variation in applied voltage is the same in each case, but the variation in current is not. The resistance of the treated carbon is almost constant through the cycle. Therefore, the fluctuations in current would be approximately the same in extent as the fluctuations in voltage. When, however, the temperature of the tungsten filament rises, the resistance rises so that when the peak of the candle-power wave is reached the lamp has a resistance considerably higher than the average during the cycle. This reduces the total candle-power variation compared with the first two items. This effect, however, is of relatively little importance.

The other considerations bearing on this problem, as, for instance, the varying emissivity of filament, will not be considered here. The important conditions which favor the minimizing of candle-power variation are, then,

Large filaments,
High frequencies.

This physical variation in candle-power may or may not be visible. The factors involved in the perception of the variation are:—

1. Brightness of surface illuminated.
2. Relative variation in illumination.
3. The frequency of the supply voltage.
4. Personal equation of observer, eye fatigue, portion of the retina use, etc.

It has been determined experimentally that the relations existing between the first three factors are about as shown in the equation:—

$$f = 43\ (IM)^{.15}$$

In this equation f is the critical frequency or that frequency above which flicker is not discernible but below which it can be noticed. I is the illumination in foot-candles which would be required upon a white surface to obtain the given intrinsic brightness, and M is the variation factor, or the total variation in illumination divided by the maximum.

Where we are considering white surfaces the equation applies direct, On dark surfaces the value for I should be corrected for absorption. If a surface were absolutely black it would be impossible to detect flicker under any circumstances as no varying light would be reflected into the eye.

*Mr. G. S. Merrill, Journal Franklin Inst., April, 1911.

The factor M depends upon maximum and minimum values of brightness only and is independent of the shape of the light wave.

Applying this equation to the case of 25-cycle current, we find that where no white area within the field of view has an illumination greater than three foot-candles, the flicker will not be observed, however great the variation in illumination. On the other hand, if the illumination is high, say 10 foot-candles, as may exist in a show window or under a desk lamp or on the ceiling where indirect lighting is used, a variation of 34 per cent. will begin to be detectable. Such a variation is about that obtained from a 40-watt tungsten filament lamp at 25 cycles. Lamps larger than this are not likely to show objectionable flicker. Under most circumstances, the intensity to be found on light colored objects constantly in view will be less than five foot-candles, which would permit the use of a 25-watt or even smaller lamp. The smaller the lamp the greater the variation in candle-power, but also, in general, the lower the illumination on nearby objects. In actual practice the smallest metal filament lamps have been reported satisfactory on 25-cycle current.

Flicker means variation in candle-power and that means variation in temperature of the filament. Variation in temperature of filament means that at different times during the cycle the lamp is deteriorating at different rates. While abnormally hot the lamp is living as if burning at higher than normal efficiency and thus has its life shortened. When cooler than the average temperature, the rate of destruction is less than normal, which would counteract to an extent the shortening of life at excessive candle-power and temperature. But these two tendencies do not exactly balance each other. The life varies inversely as the candle-power to a power ranging from about 3.5 to 4 for different classes of lamps. If the candle-power varies 30 per cent. above and below normal during the cycle, about what happens with a 25-watt, 120-volt lamp at 25 cycles, theoretically the life would

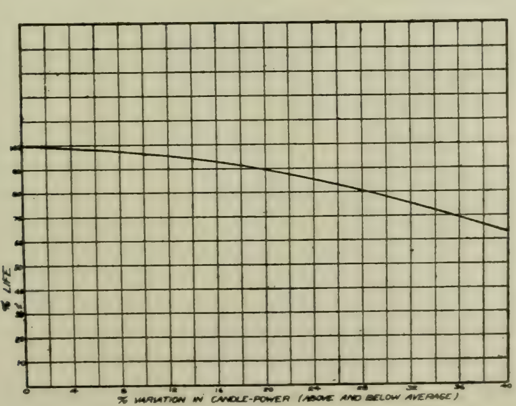


Fig 7.

be reduced to 80 per cent. of that obtained on direct current. The accompanying curve shows how this reduction varies with the range of candle-power variation. For the above lamp on 60 cycles the life is reduced only 4 per cent.

This consideration may be of importance on circuits where the voltage varies during the 24 hours but not regularly. The average value of the voltage during the time the lamp is burning may be 110, but if the variation covers 5% above and below the average a 110-volt carbon lamp will not show a life performance equal to that on 110 volts steadily maintained, but rather the performance it would show on a voltage which is about one per cent. higher than the average. While in this case the difference is small, in street railway work or on poorly regulated power circuits, it may be of very considerable moment.

The effects on life of lamps are very difficult to verify by test, because of the large number of lamps specially manufactured for uniformity, which must be used, and the great expense of running such tests, but we can be assured that the incandescent lamp will do its part and show satisfactory commercial performance if properly fitted to its circuit, at any practical frequency.

Mr. Beman gave a demonstration with a lamp.

The President: We are indebted to Mr. Beman for this paper, which is a very important one in view of the conditions in this Province. As it is almost time for the Association Luncheon we will now adjourn.

ASSOCIATION LUNCHEON.

About four hundred persons were present at the Association Luncheon, including 140 members of the Toronto Electric Light Company Section.

The President, Mr. A. A. Dion, said: "I think, ladies and gentlemen, that we have every reason to feel proud of the success of this convention so far, and especially of this magnificent gathering. For the third time, I believe, in the history of the Association we have been favored with the presence of the ladies at our annual dinner. For two years in succession they have graced our banquets with their presence, and I think it is a hopeful sign for the Association.

We are also fortunate in having with us to-day some very distinguished gentlemen connected with our industry; men whom I think it would be right to describe as leading lights in the electrical world. It is fitting also that we should gather on this particular occasion when the whole British Empire is paying honor to the King and Queen who have just been crowned. (Applause). It is fitting that some expression of loyalty should go forth from this Association, and Mr. Monro Grier, K.C., of Niagara Falls, whose eloquence and patriotism is known to many of you, has consented to address us in this connection.

Mr. Monro Grier: Mr. President, ladies and gentlemen: I do not lay claim to any great qualities, but I do lay claim to this particular

one, namely, that I have never appreciated the virtue of boring an audience just because they happened to be present in a particular building at a particular time. Now, I am going to try not to do that, but whether or not I shall succeed rests with the future.

In this connection one cannot help being reminded of the late Dr. Samuel Johnson, who said that his favorite place to talk to a man was driving in a carriage, because he couldn't possibly get away from him. Now, you to-day have the opportunity of getting away, and I do not propose to lay, so far as my influence goes, any physical obstruction in the direction of your absenting yourselves when you will. However, I must say this, in all propriety and fairness, that I think upon this particular day we can well afford to spend a few minutes with reference to the subject of the Coronation of the King of the British Empire. (Applause.)

I wish, first of all, to thank those who are responsible for such a state of affairs for the honor which has been extended to me in asking me to propose this particular toast. Frankly and freely I admit that I have not had such an honor conferred upon me before.

Now, what are we here for this afternoon—a gathering of English speaking peoples united with just one sentiment, because, so far as my view is concerned, it makes no difference whatever whether we live on that side or this side of the river, so far as regards our good wishes towards the King of England. Mark you how fitting it is that we should, in connection with an Electrical Association, do this. Just follow the argument, which is simple, and I hope plain. It was in the reign of a George of England that differences arose, that hearts were divided, and ties broken, and it is in the reign of a George—George the Fifth—that ties are re-united and hearts beating as one. (Applause.) But not only that. You, electrical men, take heart of grace in this, how absolutely well that thing which you have to deal with furnishes a figure, an allegory, in this connection. What divided these countries here? Turbulent waters; stressing and straining and fretting and keeping us apart. And we are now united. How? United by the marvellous alchemy of the scientist who transmutes that power, dividing us, into something which binds us together commercially and in other ways—electrical energy. (Applause.)

We are here to consider the subject of the Coronation itself, and I do not wish to interpose anything of a frivolous character, because it is too large and too serious and too fine a matter; but, dealing just for the nonce with the speaker, what is his position? Why, his position is that of one who finds that a number of human beings, in all good faith, are submiting themselves to the tyranny of his voice and are calmly and quietly awaiting whatever horror he has in store for them. Ladies and gentlemen, I appreciate it well, all the more on account of the appendix to an old story which I listened to the other day. The story of the man—and you, no doubt, will be able to apply it to the occasion—the story of the man who went to the late Rev.

Charles Spurgeon and said, ''Can a cornet player be a Christian and go to heaven?'' And Mr. Spurgeon said, ''Undoubtedly, but I have my doubts about his next door neighbor.'' (Laughter.) Gentlemen, I am sorry for you all that the appendix of the story is that a man came up to me and said, ''Mr. Grier, when you told that story the other day I couldn't see any fitness in it until I had heard you. It is aptness itself.'' One other remark before I pass to the subject of the Coronation, and it is in all good feeling, as I am sure my friends who frequently have the misfortune of listening to me will readily admit—in all good feeling to those who come from the other side of the river—that I tell this story in extenuation of the fact that to-day we Britishers propose to make large of ourselves. That is our intention, for it is a great day with us. We are not concealing it; we are proud of it. (Applause.) Therefore to you, our very good friends who come across the river, let me say to you, and also and particularly to all Canadian agents, whether agents of a Canadian company or Canadian agents of an American concern which has a Canadian branch, take heart and take due cognizance of this little story. It may be old to you, but it is worth while I think to repeat, and for us (so unassuming as a race we British are!), why, we take courage from it. The story is of the English lord who proposed to himself to have a breed of cows which would give more milk than any other known cow in the world. Very naturally he applied himself to the Jersey cows, and got an animal which, so far as he could tell, produced more milk than any animal in the world; but, to his horror, he took up an American paper and found, what? That in New Jersey there was a cow which altogether out-distanced his in the production of milk. In great concern—and I think this will excuse the story to our American friends, for the wit in the story is an American's, he went to the late American Ambassador to St. James, Mr. Ewarts, and pointed out this horrid state of facts, to which that gentleman replied: ''My dear sir, do you fondly imagine that a British cow can produce in a British pail as much milk as an American cow can produce in an American newspaper?'' (Laughter.)

Mr. Chairman, ladies and gentlemen, I know that this suggestion of boasting upon the part of the American people is entirely undeserved, and therefore I have to apologize for telling the story.

I would just like to say a word to supplement the language used by the chairman with reference to the presence of the ladies here. I am quite old fashioned enough to realize that the world without the ladies would be an arid, barren waste, and we should have no joy and no real happiness without them; and I am also old fashioned enough to believe that we should be the complement, each of the other, and that we shall never rise to a higher state of things than is outlined in the words of the poet and the seer, since the poet is always the seer,—''Till at the last she set herself to man, like perfect music unto noble words.''

Now, sir, to the subject matter in hand, and it will only take a few minutes. The Coronation to-day, how does it strike one? Instantly

one's mind reverts to the extraordinary growth which has taken place. What is England represented by? The oak. And what is the original of the oak? The acorn. And with regard to these things which we celebrate to-day, what was the acorn in respect of population? Some few scattered thousands of people. And what is the oak to-day? Four hundred and ten millions of people belonging to the British Empire. In respect to area, how goes it? The acorn consisted of some few hundred square miles; while the oak—listen to it—more than one-fifth of this terrestrial globe belongs to the British Empire to-day. (Applause.) In respect of the peoples owning allegiance to the English Crown, the acorn consisted simply of the people of a part of England, and the oak consists of the peoples of this immense portion of the globe itself. What does it all mean? It means that those of us who take a broad view of things are impressed with the responsibility of the occasion, a wonderful occasion—but I like to contemplate that it is, after all, just the historical outcome of things which happened hundreds of years ago. The acorn years ago consisted of what? That a man was placed upon a shield, and, lifted upon the shoulders of his fellows, stood upright, and was circled some three times round the small assembled throng. That was the manner some 2,000 years ago. To-day, what is it? To-day we have the stupendous ceremonies in Westminster Abbey, and in place of this small circle around which one could easily go in a few minutes, we have a circle which is not confined by any limits less than those of the habitable globe itself. (Applause.)

Sir, I have heard some language within the last two days with reference to central power stations, and I quite admit the immensity of some of them. I am duly impressed with them, but what I should like to point out to you is this, that this day there is a central power station which has never had its like in the history of the world before, and that is the one about the throne in Westminster Abbey with its innumerable radiating cables leading to 410,000,000 of human hearts.

But I must hurry on, so as not to keep you. All religions, all types of people, all are represented there, and will you forgive me, you who have heard me say it before, if I remark once again upon the circumstance that we have no stone Statue of Liberty, so far as I know, in the British Empire—we have not a stone Statue of Liberty within the confines of the British Empire, because we have four hundred and ten millions of monuments of liberty in flesh and blood. (Applause.)

This ceremony to-day, what does it mean? You see I am trying to hurry on as fast as I can with things which are really too great to treat in this cursory and absolutely inadequate way. This ceremony, what is it? The King is girt with a sword, which is to be used, how? To be used by the King as the Minister of God for the terror and punishment of evil-doers, and for the protection and encouragement of those that do well. It is to punish and reform what is amiss and confirm what is in good order, and the injunction to the King when the Sceptre with the Dove is delivered to him is: "Be so merciful that you be not too

remiss; so execute justice that you forget not mercy.'' And amongst the sentences sung during the service are the splendid words: ''Be strong and play the man''; whilst the prayer for the King with reference to his Empire is this: ''The Lord give you a fruitful country and healthful seasons, victorious fleets and armies, and a quiet Empire.'' In the olden days men bound themselves by allegiance to their King, and in the present day, mark the beauty of the language actually sworn to to-day by the Lords of England: ''I, Duke or Earl, etc., do become your liege man of life and limb and of earthly worship; and faith and truth I will bear unto you, to live and die, against all manner of folks, So help me God.'' That to-day is still the oath of Britishers throughout the world, and to-day we are swearing allegiance to our King, and our oath is that we will bear unto him faith and truth, to live and die, against all manner of folks. Ladies and gentlemen, these occasions do not occur often within the lifetime of living man. Just a little more than a year ago I had the sad honor of speaking on the day on which the late King Edward VII. passed away, and then I felt, as now I feel, that the language of Ian Maclaren might have been fitly paraphrased, that it was really true of the British Empire to say ''the heart of the British Empire is one and it is sore and sad.'' To-day, thanks to God, it can be said just as truly, ''the heart of the British Empire is one, and it is proud and glad.'' (Applause.)

This oath of to-day has its counterpart in the oath of olden time given by Tennyson of King Arthur and his Court, and to all of us who are Britishers especially I commend it to you. Bear it in mind, because we must always remember that if the King owes a duty to us we also owe a duty to him. I like the language of King Arthur as given by Tennyson:

> ''I made them lay their hands in mine and swear
> To reverence the King, as if he were
> Their conscience, and their conscience as their King.''

After I have sat down I shall get up again to ask you to drink the toast of the King, and before we sing the National Anthem, we will shout the two cries which to-day they shouted in Westminster Abbey: ''God Save King George,'' and ''Long Live King George.''

Sir, I am about to close, except for the utterance of some lines by the late Lord Tennyson with reference to Queen Victoria which I have ventured to change slightly, to fit the fact that we are celebrating the coronation of a King and not of a Queen. With regard to the concluding line I should like to point out that this King whom we honor to-day is essentially a king of the navy—a sea king. I like to think that, not only on the land, from the farm and the hamlet, and the busy city, all over the world, from England itself, and Ireland and Scotland, and from the outlying parts, from the great Commonwealths of Australia and South Africa, and from our own splendid Dominion, these acclamations are going up, but that he who toils upon the sea and ventures his life upon the great waters, he also acclaims the sea king. Thus it is emin-

ently proper, as I venture to think, that the aspiration which Tennyson originally uttered with regard to Queen Victoria, we all should utter with reference to King George.

'His court was pure, the ages sing,
'God gave him peace; his land reposed;
A thousand claims to reverence closed
In him as Father, Husband, King.
'And statesmen at his council met
Who knew the seasons when to take
Occasion by the hand, and make
The bounds of freedom wider yet
'By shaping some august decree,
Which kept his throne unshaken still,
Broad-based upon his people's will,
And compass'd by the inviolate sea.'

(Prolonged applause.)

Mr. Monro Grier (rising again): Mr. President, ladies and gentlemen, I have now the honor of proposing the toast of ''The King.''

The audience rose, shouting the words ''God Save King George''; ''Long Live King George,'' afterwards singing a verse of the National Anthem and giving three cheers for King George and Queen Mary on the call of the chairman.

The President: Ladies and gentlemen, we are fortunate in having among us to-day a gentleman whose connection with our industry I think entitles him to be called the father of the modern central station. I refer to Mr. Insull, of the Commonwealth Edison Company of Chicago. Mr. Insull has come from a great distance to speak to us and we shall be glad to hear him. This characteristic of the leaders of the N.E.L.A. to travel long distances, sparing neither time nor money whenever they think they can be of service to an operating company, believing that in helping even the smallest company out of difficulties they are helping the industry as a whole—this is something we should take to heart.

It gives me great pleasure to introduce Mr. Insull.

ADDRESS

Delivered by Mr. Samuel Insull, President of the Commonwealth Edison Company of Chicago

Mr. President, Ladies and Gentlemen:—

I can assure you it is not only a pleasure, but a very great privilege, to me to be allowed to be present on this occasion, and to address you on so important a day, a day of such consequence to all English-speaking people, as the Coronation Day of King George V. I had expected to have had a little celebration of my own on this occasion on a farm on the prairies of Illinois, and that my arrangements, owing to your kindly offices, should have been so changed as to allow me to spend Coronation Day on British soil, I can assure you is an honor that I shall very long remember. It is not the privilege of all Englishmen who seek their fortunes beyond the sea to follow the ''all red route,'' or to live under that ''little rag of red,'' but wherever they may be, even if, owing to the exigencies of business, they live under other flags, I think, as one of them, I can say that they never forget the Mother Country, (Hear, hear), and that whatever duty and loyalty they may feel to the flags of their adoption, they still have (and the older they grow the stronger the sentiment) a great pride in the traditions of Britain's past, and in the greatness and achievements of herself and her children of the present. We have the greatest possible sympathy for her in the time of her troubles, and the profoundest belief and confidence in the great future that lies before the English speaking people who owe allegiance to the British flag.

I wish I could express my sentiments on this subject in the way that the silver tongued orator, my predecessor, has so marvellously entertained us, but that is not possible. I am not gifted in that direction, and therefore I will leave that subject, and the occasion that must be in the minds of the whole English speaking people, whether they are one side of the line or the other, and will refer to the business in which we are all engaged, and the occasion that originally brought us here together.

I have only been here for a few hours to-day, but I have been particularly impressed with the character of your meetings, and I think if it may be taken, and I have no doubt it can be taken, as a fair sample of the sessions of your Convention, that nothing can be of so great benefit to the industry in which we are all engaged, nothing can be of so great advantage to the Canadian portion of that industry, as

an association such as yours, and the deliberations such as it was my pleasure to listen to this morning.

For a number of years past it has been my privilege to take a very active part in the affairs of the National Electric Light Association, and I should like to refer for a few moments to the work of that Association with which you have become recently more or less affiliated, and tell you some of the things that the Association has done for the industry in the country on the other side of the Gorge.

In speaking of the subject I want you to bear in mind that I am speaking from the point of view of a man responsible for the investment of vast sums of money in electrical enterprise, and therefore as one who is forced to look at it from the point of view as to whether associations of this kind are likely to be of material benefit and of financial advantage to the various companies with which you gentlemen in this room are connected. In my judgment, the work of the National Electric Light Association has done more for the improvement of the commercial methods and the engineering methods of the electrical industry in the United States than has any other one agency since the early work of the inventors who first gave us the various electric light and power systems which we are engaged in operating. This Association has aided very materially in fostering pleasant relations between our various member companies, and the communities in which they do business. It has added very largely to the knowledge of our employees, and consequently has added very much to their efficiency, and we are now engaged in endeavoring to introduce schemes amongst our member companies with reference to such things as pensions, saving funds, insurance, and the like, for the purpose of adding to the material welfare of the employees of the various companies who are members of our Association.

The business in which we are engaged probably has few parallels in growth in the industrial world. Three decades ago there was scarcely more than a few hundred thousand dollars invested in it, while to-day there is probably a billion and three-quarters of dollars invested in the electric light and power industry in the United States and Canada, and there is probably employed by the various companies from one hundred to one hundred and fifty thousand men; moreover, notwithstanding its remarkable growth, the business has, on the whole, paid handsome returns on the capital invested. It is a business which is probably less affected by panic and depression, which we must expect from time to time, than any other public service industry. This may be partly owing to the fact that we are engaged in a new business, and that we have not reached the point of saturation, and our efforts to extend our operations are somewhat sharpened when we find periods of depression in general business approaching.

Being at this location, right in the centre of what is popularly supposed to be the greatest power development on the North American continent, naturally one would refer to the question of hydraulic develop-

ment, but it happens that practically my entire experience, with the exception of a few isolated cases, has been confined to steam development. Sometimes I wonder why it is that the public, whether they are in Canada or the United States, look upon Niagara as the greatest power production centre in this country. My own impression is that the greatest power production centre in this country at the present time, if you include all the various electric light and power companies and transportation companies, the greatest power production centre in the United States, is in the City of New York. I want to add, however, and I say it with all modesty, and with the recollection of Mr. Grier's remarks with reference to the possible boasting characteristics of the people who live on the other side of the line (and in respect to that point it is at least one quality which they have inherited from their English forebears), I would repeat, I say it with all modesty that I think the largest steam-electric power production centre in the United States operated by one company is probably in the city of Chicago, and the company is that of which it is my honor to be the president.

There are a number of gentlemen in this room whose business is menaced more or less by the hydraulic development on the Canadian side. I want you, when you go home, to figure out what is your investment per kilowatt of maximum output, and divide that investment into two classes, one the generating investment and the other the distribution investment. You will find that your average investment—which I do not think is any different in Canada than in the United States in this respect—you will find your average investment in the distribution system is just about five or six times your average investment in your generating plant. So when you hear that Niagara power is coming into your midst, and that the investment for the production of Niagara power is apparently some absurdly small sum per kilowatt of maximum output, please remember that before that hydraulic development can be used to any extent in your community there must be invested exactly the same amount of dollars in a distribution system as you have had to invest, and that your case is by no means so hopeless a one as it would appear to be if you just take the information on the surface—the apparently correct information—and do not go to the bottom of the thing.

I suppose some might consider this a wild statement to make, but I have thought for a good many years past that a steam generating plant located in the city of Buffalo could compete, under the conditions under which power is sold in Buffalo and must be sold in Buffalo, owing to the conditions under which business is done, and the conditions under which people live, and so forth, with electric energy brought from one of the hydraulic plants here at the Falls.

I didn't come here with the idea of addressing you in any set speech, so I am not going to occupy you to any great length on so fine an afternoon as this, with the temperature as high as it is in this room. However, before I take my seat I want to address a few remarks to the young men here. I want to say to the young men attending this Con-

vention that I know of no business which offers so great possibilities of advancement and for an honorable career as the business that we are engaged in. Some might say that it is natural I should make such a statement because I know no other business; but, speaking from my own experience, and speaking from the experience of a great many young men who have grown up with me in this business, a great many men who to-day are looked upon more as the fathers than the sons of this industry, I say I know of no business that affords greater opportunities for you young men. The positions that you can achieve, the advantages that may accrue to you in the business, rest entirely with you. You have before you the opportunity to obtain the knowledge to fit yourselves to occupy positions of prominence in this industry, and naturally those positions must bring with them the advantages and the emoluments that come with prominence and that come with success. It is simply a question of whether you will rise to the occasion when it is offered to you, and whether you will grasp the opportunity that is before you. Whether you are in a small country town or in a large city, you should take advantage of the opportunity to gain a knowledge of the business that is right at your hand. I know of no better agency by which to get that knowledge of your day-to-day work than by forming a connection with such an association as yours or the National Electric Light Association. I know of no place where you can get better engineering knowledge, better commercial knowledge, better advice as to what to do under all kinds of circumstances, than you can get from the National Electric Light Association and its affiliated body, the Canadian Electrical Association.

To those gentlemen here who are responsible for the operation of properties, I want to say that they cannot spend their company's money to better advantage than by sending their young men to meetings of this Association, if the meetings are of such a character as the one I attended this morning, (Hear, hear), and in offering them that advice I am only preaching what I practice, and what is practiced by the managers of all the large electric properties in the United States. We only limit the number of men that we send to our Conventions by the necessity of considering the question of how we can get along in our business with so many men absent.

Before I sit down there is one other subject to which I should like to refer. It is a subject that was referred to, I think, in two of the the operating companies, the public utility companies, and the communipapers this morning, and that is the question of the relations between ties in which they operate. This is a question that has been very much discussed in the last few years. The old method of doing business was to assume that a public utility was a class of supreme beings that could not possibly make a mistake, and if the community in which it operated was not satisfied with the methods, why it must just put up with them. I care not how good may be the franchises under which you operate, how long may be the grants you have, how able may be the management of

your property so far as the engineering side of it is concerned, or how good may be your engineer and how perfect your plants, unless you can so conduct your business as to get the good will of the community in which you are working, you might just as well shut up shop and move away.

This matter of public relations is one that has been brought home to a great many industries, not only public service industries, but all classes of industries in the United States in the last few years, and I think you people on this side of the line might very profitably study what has been going on in connection with public opinion in the United States, and the relation of public opinion to corporate affairs.

Most of the troubles that have occurred in the United States found their origin in an absolute neglect of public opinion in the case of general industrial corporations, and in a neglect of local good will on the part of the local public service corporations. Having obtained a franchise, if you are men dealing with the public from day to day, the first thing you want is their good will, and if you are managers of properties the first thing you want on the part of your employees is to see that they do everything to get that good will. I do not mean to say that you should give way to every whim or caprice, or that you should bow to every demand of the politician who is bidding for public favor. That is not at all necessary in order to get general public good will. You have to remember, as one of your members stated in his paper this morning, that the community are your customers, and that you have to put yourselves in the position of your customers. Suposing one of you went into a store to make a purchase and you wanted a certain article, say an article of apparel, of a certain color, say white, what would you think if the clerk behind the counter reached up for a roll of goods and said, "Well, our rule is you have got to take green." You would walk out and go somewhere else, and if you wanted white you would buy the article at some other place. Now, there are a great many things that public utility companies do that are just as absurd as that, and my last word to you is, above franchises, above all questions of money making (because that will help you to make money), above all questions of engineering, consider your relations with the community in which you are working and in which you have to live, because your plant cannot be picked up and moved away.

The President: That the splendid, eloquent and practical address of Mr. Insull is fully appreciated may be judged by the applause. (The President put a Union Jack in Mr. Insull's button-hole.) "Behold a Britisher." (Applause.)

This address, ladies and gentlemen, brings these exercises to a close, and we will now take the cars for a trip to Chippewa, where a splendid programme of aquatic sports has been prepared.

Mr. Frederic Nicholls: I think at this official function we should not depart without drinking the health of our efficient president, Mr. Dion. "Gentlemen, Mr. Dion!"

After drinking the toast, the audience joined in singing ''For He's a Jolly Good Fellow,'' and gave three cheers for President Dion.

The Convention then adjourned till Friday morning.

MEETING OF EXECUTIVE SECTION.

At the meeting of the Executive Section on Friday morning, the following officers for the ensuing year were elected:

President: A. A. Dion, Otawa Electric Company, Ottawa.

1sst Vice-President: R. F. Pack, Toronto Electric Light Company, Toronto.

2nd Vice-President: W. L. Adams, Ontario Power Company, Niagara Falls, Ont.

3rd Vice-President: W. L. Bird, Kaministiquia Power Company, Fort William, Ont.

Secretary-Treasurer: T. S. Young, 220 King Street West, Toronto.

Managing Committee: J. S. Norris, Montreal Light, Heat & Power Company, Montreal; W. C. Hawkins, Dominion Power & Transmission Company, Hamilton, Ont.; L. V. Webber, Toronto Electric Light Company, Toronto; R. H. Sperling, British Columbia Electric Railway Company, Vancouver; A. L. Mudge, Electric Power Company, Toronto; C. E. A. Carr, Quebec Railway, Light & Power Company, Quebec; F. A. Chisholm, St. Johns Electric Light Company, St. Johns, Que.; I. H. Wright, North Bay Light, Heat & Power Company, North Bay, Ont.; J. H. Larmouth, Electric Power Company, Belleville, Ont.; J. W. Purcell, Walkerville Light & Power Company, Walkerville, Ont.; W. Phillips, Winnipeg Electric Railway Company, Winnipeg; D. H. McDougall, Toronto Power Company, Toronto; J. W. Crosby, Halifax Electric Tramway Company, Halifax, N.S.; R. B. McDunnough, North Shore Power Company, Three Rivers, Que.

GENERAL SESSION—THIRD DAY.

The President, after calling the meeting to order, asked Mr. Charles F. Scott to read his paper on ''The Importance of Co-operation Between the Central Stations and the Electrical Manufacturers.''

THE CENTRAL STATION AND THE MANUFACTURER

By Chas. F. Scott.

Co-operation between the central station and the manufacturer of apparatus will be treated for convenience under three heads; first, "Engineering," which will deal with the apparatus by which the central station produces and distributes its current; second, "Commercial Engineering," which will treat of the apparatus (such as motors, lamps, and heating appliances), and the methods for extending the use of central station service; and, third, "Commercial," which will deal in a more general way with the common commercial interests and prosperity of the central station and the manufacturer.

Engineering.

Good apparatus well operated is the engineering basis upon which the whole central station business rests. It is useless to expect good service from badly designed or badly built apparatus in which central station operators have no confidence. How can the central station co-operate with the manufacturer to secure better apparatus?

Standard apparatus should be purchased if it will meet the requirements. Modern manufacturing is based on the principle of duplication, of making things in quantity. Designs are carefullly prepared and are modified as experience directs so that much of the standard apparatus of to-day is the outcome of years of evolution in which the best thought of the designer, the best skill of the factory and the results of experience are combined. Patterns, dies, tools and the experience of the workmen all are available for the making of a standard product in less time and at less cost than a special or new one which has not had the test of experience in service. Hence, whatever the individual central station or central stations together, can do toward the standardization of voltages and frequency and the acceptance of standard types and sizes of generators and auxiliary apparatus will not only assist the manufacturer, but will, in the long run, bring to the central station better and cheaper apparatus.

Conference with the manufacturer before deciding upon a definite type or size of generating unit or other apparatus may be helpful in determining what standard apparatus is available which will most nearly meet the requirements. Substantially the same results or sometimes even better results, can be secured, as the result of such a conference, giving a gain in first cost, in time of delivery, and in securing machines which are of a standard type, thereby avoiding the expense which is incident to special apparatus. The central station is thus assured of getting the apparatus most suitable for its service by securing

the advices of the engineering department of the manufacturer which is necessarily in touch with the new and changing conditions and with the operating requirements of other stations. The wisdom of such a conference is obvious, yet it is not uncommon for rigid specifications to be presented without conference and without provision for alternative propositions.

On the other hand electric practice is continually developing. We must continually improve and progress. New conditions arise. To improve his apparatus, the designer should know just what it must do. He may surmise the conditions, and he may make laboratory tests, but these may not be the actual requirements and conditions of service. He needs the experience which the central station operator possesses Lightning arresters, for example, designed according to theoretical principles and tested in a laboratory were liable to some startling surprises when installed on operating circuits. The development of the present arresters has come about largely through the visits of the designing engineers to the power houses and circuits of the operating companies, and through the assistance rendered by the operating engineers. Likewise regulators, switches, circuit breakers and instruments are the outcome both of the laboratory and experience in actual service. Now the experience of the central station operator can greatly assist the manufacturer. To be effective, there must be freedom and frankness—not mystery and secrecy. If something is not satisfactory, if there is some weak point in the apparatus, if there is some new condition which is not met, little is gained by saying that the whole thing is a failure, while much may be gained by definite, intelligent information.

Conditions are rapidly changing in central station designs and substantial engineering progress requires that the skill of the manufacturer and the experience of the operator be combined. Perfect apparatus we can hardly hope for, but we shall come more nearly to attaining it as the engineers of central stations and of manufacturers, recognizing that they have common problems, set about to solve them in a businesslike way in which each contributes his part.

Commercial Engineering.

The growth of the off-peak load and of the power business is the most striking feature in central station activity at the present time. Motors are replacing engines in industrial plants; they are finding new fields in domestic and commercial use to an extent not thought possible a few years ago.

This development is the outcome of a new type of engineering study and commercial activity. The application of electric power is first of all an engineering problem. A motor must be adapted in speed and power, and in mechanical connection, to the work which it is to do, But beyond these simple problems is the general problem of using to best advantage the power which the motor develops. It is the superior service which the motor gives, the convenience with which it can be oper-

ated, the better speed adjustment, the increased quantity or the improved quality of the output of the machine it drives, the simplicity of motor drive as compared with engines and shafting and belts, and the independence of one tool or one department from others when driven by separate motors—these and a score of other factors are indirect advantages which often become the really important things to be gained in using electric power.

Hence, it is the specific, the particular, and the definite adaptation of electrical appliances which bring results. The knowledge of how to accomplish these results comes through careful investigation and experience. This is often beyond the scope of the individual central station company, but it is something which must be undertaken by the manufacturing company, as it must know what are the exact conditions in order that it may design its apparatus so as to meet them effectively For example, if a motor is to operate a certain tool, the designer must know the maximum power, the average power and the need for speed adjustment and variation. He must know these things in their relation to each particular machine or industry. He naturally acquires an intimate knowledge with the power requirements and the power consumption in actual practice in many places. He also determines the advantages and disadvantages which result in actual experience under many different conditions. It is just this kind of knowledge and experience which is essential to an intelligent and successful building up of the motor business.

The prospective user of electric power is often unfamiliar with the apparatus and the various engineering features involved in its application and operation, and he is ignorant or unconvinced of the advantages which will result from its commercial introduction. Hence it is that the large power loads of progressive central stations have been the result of a systematic educational campaign among prospective customers.

This is a field in which manufacturing company and central station can work together. The information and data which the progressive manufacturing company necessarily acquires in order to design its apparatus to meet the requirements of actual service are the precise data which the central station needs in order to understand and effectively present the situation to the power users which it should serve.

Electricity applied either through motors or lamps or heating devices is usually an auxiliary factor. The cost of the electric power is a small part of the total cost and yet it may contribute very largely to successful operation. For example, the cost of power in most industries is only three or four per cent. of the total cost of the product and the cost of lighting is less than one per cent. Hence, it follows, obviously, that if greater and better output can be obtained from men or machines by an increase or an improvement in the power or lighting, then considerably greater expense for light or power is amply justified. This may be illustrated by an example: Assume as a convenient figure that

the cost to the purchaser for a 5 h.p. motor is $100.00. Assume further that the annual charge for depreciation, interest and repairs is $20.00 per year, or say $.07 per day. In the daily cost of production, therefore the first cost of the motor appears as 0.07. The power taken by the average 5 h.p. motor is say 2 k.w. (corresponding to a load factor of 40 per cent.); hence, the power for the 10-hour day will be 20 k.w.-hours and, if the rate is say, $.025 per k.w.-hour, the cost will be $.50 per day.

If the motor drives a line shaft supplying power to five workmen at $2.00 per day, their wages will amount to $10.00 per day. The various overhead charges in the operation of machine tools is about one and one-half times the operators' pay. (See "Notes on the Cost of Operating Machine Tools," A. G. Popcke, Electric Journal, December, 1909). This gives the overhead charge as one and one-half times the wages, or $15.00 per day.

The various items assumed in the total cost of production, all in connection with the 5 h.p. motor, in the present typical case, are as follows:—

Cost of motor per day	$ .07
Cost of power per day	.50
Cost of wages per day	10.00
Cost of overhead per day	15.00
Total cost per day	25.57
Total cost per hour	2.56
Total cost for twelve minutes	.50
Total cost for one minute	.04

Let us analyze: The cost of power is $0.50 in a total of $25.57 per day, or only 2 per cent. of the total. Suppose that it be possible by using more power to slightly increase the output, note what will result. If the power used were increased one-tenth, making $0.55 instead of $0.50 per day, and this can increase the output by, say, 5 per cent., then the production will be increased in value by 5 per cent. of $25.57, or a little more than $1.25. Hence, $0.05 more spent for power would result in a net gain of $1.20 under these conditions, or twenty-four times the cost of the additional power. These figures may be put in the following form:

Assumed gain in production (5 per cent. of $25.57)	$1.25
Assumed additional cost of power (10 per cent. of $0.50)	.05
Net gain	$1.20

Expressed in another way, the cost of power per day is $0.50, which is equal to the total cost for 12 minutes; i.e, one can afford to pay twice as much for power if he could thereby gain more than 12 minutes per day. Hence, **the problem is not to save power, but to use power effectively.** The cost of power is so small an item in the present example that it can be even doubled if a gain in rate of production of more than 2 per cent. can be secured thereby.

The cost of the motor in the foregoing example is equivalent to $0.07 per day, or approximately one-quarter of one per cent. of the total cost. Obviously, if some other motor equipment would give even 1 per cent. greater output, the value of which would be $0.25 per day, it would be economical to install it, even though it cost twice as much, i.e., even though the motor cost $200 instead of $100, or $0.14 per day, instead of $0.07.

Expressed in another way, the cost of the motor per day ($0.07) is less than the total cost for two minutes ($0.08). Hence, if one motor equipment will save more than two minutes per day over another one, its purchase is justifiable even if the price were twice as great. If, therefore, one motor outfit can be more conveniently operated, if starting or stopping requires less time, if there is less interruption due to poor insulation or hot bearings or controller contacts, which amounts, on the average, to even one or two minutes a day, or to one hour a month, then it is well worth while to purchase the better outfit even at a very considerably increased cost.

The same line of argument may be used in comparing group drive with individual drive. It is well known that the power consumption is, in general, less with individual drive than it is with group drive, but that the first cost of several small motors is more than the first cost of one large one. If, however, the cost of motors is a small part of the total cost (in the above example it represents less than 1 per cent. of the total cost of production), then it will be economical to use the individual drive, provided that even a few per cent. increase in output can be secured. Often the elimination of delays due to belt repair, shafting troubles and the like will alone much more than make up for a very considerable increase in the first cost of motor equipment.

Hence, in view of the foregoing analysis, it is poor economy to try to economize by reducing the amount of power used, provided more power can make even a slight increase in the output.

Further, it is poor economy to try to economize in purchasing motor equipment, because any appreciable gain in production will much more than offset the increased cost of the best possible equipment.

The figures in the foregoing example are assumed, but the actual figures applying to any practical case will usually lead to similar conclusions.

In the departments of lighting and heating, there is a similar situation. As the applications of electricity become more specialized, they are being handled in a scientific way. In incandescent lighting, for example, the advent of the tungsten filament lamp is coincident with the rapid progress of the science of illuminating engineering. Formerly an incandescent lamp was placed wherever there would ordinarily have been a gas jet. Now, correct lighting is laid out by illuminating engineers. The comparative newness of this work is illustrated by the appendix to the lecture on "Illumination Calculations," delivered in the series of lectures on Illuminating Engineering at the Johns Hopkins

University last Fall. Following the lecture is a Bibliography of Illumination Computations in which there are references to 36 different books or articles. Two of these are without date, a few appeared in 1906, and all the rest have a later date. In other words, the literature on Illumination Calculation is just about as old as the tungsten lamp

The manufacturers of lamps and of reflectors have made a scientific study and practical investigation as to the best ways of using their products, and are ready to aid the central station in specifying good illumination. This is bringing about a new era in electric lighting. Ten years ago, there was the small carbon incandescent lamp and the carbon arc lamp. These had existed with little change for twenty years, but within the past decade have come new lamps of various types, taking less than half the energy for the production of the same light, having a wide range in candlepower and leading to a scientific treatment giving practical results which were before unattainable. Simple as these things are from one point of view, yet they are not understood by the general public, and the application of what is now available can come only through the progressive commercial presentation of the engineering principles which are now established.

The purpose of lighting offices and factories is to enable the workers to do their work: good lighting promotes speed and accuracy by enabling things to be seen better and also by placing the workers in more agreeable and cheerful surroundings, and often by removing the cause of eyestrain and headache. Now, the total cost of lighting is trivial compared with wages, and the difference in cost between good light and poor light is often less than 1 per cent. of the cost of the wages. In other words, if an amount equal to 1 per cent. of the wages be used for improving the lighting, a gain of many times this amount can be secured in the quantity and quality of the work produced.

Likewise, in heating appliances, the field is new, the conditions of application are varied, the fundamental facts and the resulting advantages are not understood by the general public, and there is again necessary an active commercial effort along sound engineering lines in order to develop this field. Here again the designing engineer and the manufacturer who has made a study of the conditions under which this apparatus can be applied, is ready to lend most valuable assistance to the central station in the extension of this work.

In cases where the first cost of a motor is small compared with the cost of the power that it consumes, and where the cost of heating or other current-consuming devices is small compared with the value of the current which they use, the central station has the opportunity of furnishing upon favorable terms, or even free, the motors or heating apparatus with the expectation that the income from the current used will pay a handsome profit.

In the 5 h.p. motor which has been cited as an example, the cost of the motor is 7c. per day, whereas the value of the current it uses is

$0.50 per day, or seven times as much. A flat-iron or luminous heater soon consumes current far beyond its original cost. Even the economical tungsten lamp of average life consumes current equal to many times its first cost. The first cost of carbon lamps is so low, compared with the current they consume, that the free renewal of lamps is a common practice. The ordinary person, however, probably objects more to pay $0.20 or $0.25 for a lamp than he does to paying $3.00 or $4.00 for the current it may consume. Likewise, a man may hesitate to pay $100.00 for a motor although he may be perfectly satisfied to pay $200.00 per year for the current it uses. Hence, a study of the relations between first cost and power cost will often open the way by which the central station can cultivate the habit of using electricity by a generous policy in the furnishing of apparatus.

We are all apt to take too narrow a view; we fail to see that the really important thing is not the saving of a few cents in doing a thing by the old way, but in the large economies which come from new methods which electricity makes possible. Efficiency in operation and in management as well as in power plants and in machinery is now awakening interest and wide discussion. Electricity is the great modern means of securing efficiency in the applications and uses of power. The progressive men of manufacturing companies and of central stations are beginning to recognize this and through their efforts it is beginning to impress itself upon the public. The problem is a tremendous one, its solution means much for the public, for the central station, and for the manufacturer, and it merits united effort in its solution.

Commercial.

In their commercial prosperity and success, as measured by the earning of dividends, the manufacturer and the central station have much in common. One supplies apparatus, the other operates it, and together they contribute to supply a growing need of the community. The central station is no longer a novelty supplying current within a radius of a mile or so to those who can afford the luxury of an incandescent lamp upon a combination fixture where the gas can be lighted when the current fails, but in recent years these small companies are uniting into large systems. Hence, light is no longer a luxury, but the company is now called a Public Service Corporation. It is recognized, both practically and legally, as an institution which supplies a fundamental need by rendering a public service to the community. Government commissions see that the public is provided with an adequate service at fair rates and also that the company is protected against unju t competition and that it secures rates which are fair and adequate.

Moral and legal obligation, as well as good business policy, dictate ''at the central station should supply the best possible service and should extend that service in the public interest as well as its own interest. This means that the central station must provide a reliable and continuous service; that it must not merely be ready to supply cur-

rent, but that it must also render a public service in showing how to use electricity and how and what direct and indirect gains follow from its use, and, further, it must develop in its equipment and in its organization to meet the larger field of service which the universal use of central station power will make necessary.

Continuity of service has a new importance when not only lamps, but street cars, and elevators, mills and factories and the conveniences and necessities of the store, the office and the home are dependent upon electric power. Fundamental to such service is good apparatus. Some of the ways in which the central station can co-operate with the manufacturer in designing and manufacturing such apparatus have already been considered. There is, however, another, the commercial standpoint.

The central station in fairness to its patrons and for its own success requires the best possible apparatus. Differences in first cost are trivial. The loss of direct revenue from a short interruption to service (not considering loss of prestige, and the cost of repairs) will much more than compensate for the difference between the cost of inferior apparatus and the cost of the best. Not only should the best apparatus be bought, but it should command a fair price. The manufacturer who makes the best should be supported and he should be encouraged to make his apparatus still better.

In the applications of power which have been considered under "Commercial Engineering," it is to the common interest of the user, the central station and the manufacturer that the results should be successful. This means that adequate apparatus must be properly applied. From the standpoint of the customer, reliability and continuity of service are of first consequence. These depend, first of all, upon the quality of the electrical apparatus which is used. As the first cost of this apparatus is insignificant compared with the cost of the power it uses and the value of the products which it aids to produce, quality and not price is of first importance in the installation of a motor. Whatever the central station can do to aid its customers in securing good motors; whatever it can do to support the manufacturer who makes good motors and to induce the making of still better motors, contributes to the best interests of all concerned. The central station and the manufacturer together, by educating the public to the use of electricity in the right way on a sound engineering basis with the best apparatus are laying the surest foundation for their commercial success.

Looking to the future, there is a wonderful outlook for the central station if we may estimate the future by the past. Twenty years ago, arc lights, incandescent lamps and street railways were operated from three different types of generators, few of which exceeded a few hundred k.w. in capacity. Ten years ago, the steam turbine was being talked about and power load from central stations was beginning to be seriously considered.

To-day, the polyphase alternating current generator supplies electric service of every kind and it is demonstrated that the large central sta-

tion plant is the cheapest to install, the cheapest to operate and the most reliable in the service which it gives. The uses of power are extending, isolated plants are disappearing, the domestic uses of electricity for light and heat and power are increasing, innumerable appliances for using electricity are constantly appearing, the railway terminals of the great steam roads and the electrical operation of suburban and trunk line service are matters of the immediate future. The central station should be the source of power for all purposes.

To insure that the electrical progress of the next decade will keep pace with that in the past, the central station must meet the new demands for reliability and for a broad, comprehensive expansion of its activity and its policy. Apparatus larger in output and better in quality will be demanded for generating, controlling and using electric power in all forms. The experimental investigation and the practical development of apparatus has been carried on in the past largely by the manufacturing companies. They have expended millions of dollars in developing new and better apparatus and the central station has reaped the direct benefit. Such work must go on, it must be aided both by engineering co-operation and by the commercial endorsement of the central station interests.

Modern civilization has been brought about by the steam engine through its effect on transportation and manufacture. Electricity is bringing about a new power era, because it facilitates the generation, the transmission, the distribution and the universal application of power. The central station is the agency for supplying this power. Upon its progressive policy in acting with the manufacturer of apparatus on the one hand, and the public on the other, depends the commercial prosperity of manufacturer and of central station, and the general welfare of the community whose industries and transportation and daily life are becoming more and more dependent upon electric power.

DISCUSSION.

Mr. Black: It is not often that we have a man of Mr. Scott's ability and knowledge in these matters available, and I think we should take full advantage of our opportunities to ask him a great many questions. By way of starting the ball rolling I would like to ask Mr. Scott what the probability is of getting more coil wound induction rotor motors in this country. It is true that they cost a little more, but it might be of very great advantage to the consumer to have a coil wound rotor motor instead of a squirrel cage motor. We find in our large installation there is trouble with the circuit breaker opening at the sub-stations and also on the customer's premises, as a result of getting the circuit loaded up, and then starting large squirrel cage motors, due to the abnormal starting current.

Mr. Beman: Mr. Scott has shown how little difference in the performance it takes to make a $200 motor cheaper than a $100 motor, and the same thing can be applied to other appliances. In the matter of

lamps, we find that the average man will purchase a certain lamp that he can get five per cent. cheaper than another lamp, although the latter is worth 40 per cent. more in service to him. He has not the facilities frequently of finding out the difference in the performance of two lamps which may come to him at different prices, but it is only logical to suppose that a lamp which will give five per cent. better service either in light or candle-power maintenance will be worth paying more for. As a rule, by careful discrimination and by actual test it will be found that the difference in performance or service is greater than the difference in the price of the lamps on the market. In lamps, as well as other apparatus, therefore, the test of service or performance should be applied as a guide in purchasing.

Mr. Lambe: Mr. Scott's address to my mind is certainly of the highest type of paper that can be given at any convention, and therefore we ought to be very thankful indeed to have a chance of hearing him. I have a few notes on one or two points which he spoke of; the first is standardization. In this country, while standardization is of inestimable value, we are in danger of carrying it to excess, and the same is true of the States, while on the Continent of Europe—in England particularly—they are said to carry what we might call "indiscriminateness" to excess, because their apparatus is something like Eaton's hats—guaranteed no two the same—their frequencies and speeds varying in every direction. However, standardization is a great step towards cutting costs down, and cutting the delivery down, and getting goods properly built, because standardization means that apparatus once designed and laid out on paper and put onto blue prints can go into the hands of the actual workman who is going to make it, and the engineering force and the executive force need not thereafter pay any special attention to it. Such standardization, however, means that any changes required, though really minor in themselves, entail heavy expenditures, in many cases apparently out of all proportion to the results. This may perhaps best be illustrated by the case of a man who wants a generator panel with five feeder switches on it. The nearest standard that can be offered him will probably have six switches. Now, if he insists on changing this to five, as occasionally some one will, that changed board containing but five switches is going to cost more than the standard containing six, it is going to take longer to deliver, and then there may be a mistake or two in it. This is but an odd illustration of what frequently happens in many other lines as well as switchboards, but it brings out the point that while standardization is undoubtedly of tremendous value, still there is the other side to this as well as to every other question.

Then there is another point, and that is the question of the cost of power. We are apt to say that the main thing is the cost, but that is not the case. For instance, not long ago I went in to see a personal friend of mine, who said, "we have changed over from our steam power, since I saw you last, to electric power. If you fellows could actually

run a plant the way you figure it on paper when you are trying to sell it, you would be a mighty sight better men than you are. Why, our power is now costing twice what it used to with steam.'' I thought for a minute I was hard up against it, but I started to remember some old lessons that had been given me, and so said: ''Well, but you must remember that you are getting lower insurance now, and you can get power at any hour of the day or night, and you can run part of your shop without running the other,'' and so forth. That this just fitted his case, as it will that of many other steam plants if you get after them, is evidenced by his instantaneous answer. ''Oh,'' he said, ''that is all right, we wouldn't go back to the old conditions for anything.''

Then another thing I would say to the central station men particularly, in connection with the exhibition rooms—have people in charge of those rooms who know the goods, how they are made and how they are used, so that they can give correct information to enquirers. I mention this because I have lately been in a couple of large exhibition rooms, as an entire stranger, and got information given me which was, to put it plainly, because there is no use glossing over these things, absolutely and entirely wrong, and the men who gave it could not be persuaded that they were wrong. Now, that produces a bad impression, and therefore I say, have your men know their business, have them know it thoroughly.

Then one other thing that comes up in connection with central station service, and I think we are to be congratulated on having at least two Canadian companies who have taken up the matter—if Mr. Coate is here it would be nice to hear him speak on it—and that is, steam heating from your exhaust steam. In Brandon, Manitoba, they have recently put in such a system, which I understand is turning out to be a little gold mine. Mr. Coate, I think, has one in Chatham, and perhaps Mr. Scott also will give us a few words on the question.

The President: A thought which occurred to me while Mr. Scott was reading his paper. Mr. Scott has a peculiar faculty of preparing papers that are immediately useful to everybody; papers that send you home with some thoughts in your mind. It makes you hurry home to put them into execution as soon as you can, and that is really the true test of the value of a paper.

Mr. Scott has spoken of the desirability of co-operation between the central station and the manufacturer. I think there is no question about it, that a manufacturer can help the central station and the central station can help the manufacturer, but possibly one reason why the central station does not co-operate with the manufacturer as much as it should is due to a sort of shyness on the part of the central station men. He knows the manufacturers have their apparatus designed by men who are eminent in their profession, and with the exception of the very largest stations who employ men who are very sure of their ground and who are not afraid to discuss things with these eminent designers, they feel rather diffident about going to a manufac-

turer and telling him what he ought to do. I think perhaps the manufacturers could do a little more educational work by going among the central station men, making them feel that they need not be afraid to tell them their troubles be they as small as may be. One doesn't like to be ridiculed, and one will not go to an engineer who is high in the profession and tell him he is wrong in a certain form of apparatus, unless he gets a good deal of encouragement to do so.

Regarding the spreading of the use of electricity through educating the public, I always feel that the small and the medium companies are at a serious disadvantage because they cannot, or think they cannot, employ specialists to introduce certain apparatus. I refer particularly to the use of power in its various industrial applications. Now, the average solicitor is not successful in that line of work, because it requires a very high order of education, as is very clearly shown by the illustration that Mr. Scott has given. It is necessary to analyze the costs and show to the prospective customer just where he stands, and this cannot be done by anybody. A few days ago in conversation with a gentleman responsible for the operation of one of the largest plants in America, he said to me, how much do you suppose you could afford to pay a specialist for things of that kind? Would so and so be too much? I almost gasped. I said, yes, we couldn't think of anything like that. Now, he said, stop and think a minute. Supposing that man got you so much new business during the year would you grudge him that amount of money? I thought a little, and I said, no, because this salary represented a small percentage of the business obtained. Well, he says, I can get you a specialist that will get you that much business. So there is a feature that you must not forget. We are afraid to spend money for soliciting, but it must be considered not in the light of the salary but in the light of the amount of business secured. Since Mr. Scott has invited suggestions I will make bold to make some. Might it not be possible for manufacturers to employ high grade men, engineers with the commercial instinct, who would be successful in introducing the use of industrial appliances, whom they could loan to companies for the purpose of carrying on a canvass. Let us suppose a man who gets $400 a month. There are many companies who would hesitate a great deal before paying that salary, but perhaps they would not hesitate to pay it for one month or two months to carry on a campaign, giving the particular business a fair start.

I wish to emphasize the importance of reliability in service as the first consideration for an operating company. We have heard a great deal during this week about advertising, and suggestions of various progressive methods of securing business. It is my firm conviction that you will lose all the benefits of these different forms of advertising if you do not maintain a reliable service. It has sometimes occurred to me that manufacturers might be of benefit to the central station in the building of their power business by incorporating in the motor, as a part of it, or of an attachment, that would go with it, an automatic

starting device. It would prevent the difficulty which central stations encounter due to the opening of circuit breakers. If you have to wait after the opening of a circuit breaker for four or five minutes to give time to your customers to get the motors off the line, you have a very serious condition, and one which will operate against you in soliciting more customers for power. It is quite true that a customer should have a proper starting apparatus, but unless it is sold as part and parcel of the motor it is difficult to get him to buy it in every case, and where you have competition it is almost impossible to enforce any regulations in that respect.

Mr. Scott has spoken of standardization, and Mr. Lambe has confirmed his remarks, and we all understand, I think, the advantages of standardization of apparatus. On the other hand, I would like to give voice to objections that I have heard against standardization, merely to give Mr. Scott a chance of refuting them. It has been said that the American and Canadian manufacturers in their efforts to standardize everything, were holding back progress and retarding the introduction of improvements, because it meant to them the throwing away of a lot of dies and other apparatus which they had used in standardization. I am not prepared to say how much there is in that objection, but it would be interesting to hear Mr. Scott on that point.

I would like to say another word about exhibitions. I have attended electrical exhibitions in some of the large cities where the leading manufacturing companies were exhibiting. They had spent a great deal of money in making a display. These displays were no doubt in charge of men of great ability, but these men naturally would get tired staying around a booth all day, and I have been to those exhibits when they were in charge of young men who were absolutely unfit to take care of them because they were apparently unable, and certainly unwilling, to give the required information. I have sometimes asked for information and I have been looked at with a cold stare as if I was committing a breach of good manners. Now, these exhibitions are not held very frequently, and they are a source of very great information to the central station if they can get from the attendants the information they wish to have and which they are entitled to have. I trust, gentlemen, that you will discuss this matter more fully. It is a most important paper.

Mr. Kemble: A paper like Mr. Scott's is not only of advantage to the technical man, but to the commercial man as well, and I wish to take a moment of your time in connection with it. I think I am not exaggerating when I say that 50 per cent., if not 60 per cent., of the salesmen who are used on power business have received a large part of their training with the large manufacturing companies. The manufacturing companies take these men in and pay them a salary which is not large, but which is more than they are worth for some time. They train them and give them a good grounding, and then let them go over to the central station men, and I think that is a factor of co-operation

on the part of the manufacturer for which he has not been given due credit. Personally, I find it of the greatest possible value to have solicitors or power salesmen who have had one, two or three years' experience in large manufacturing companies where they have been taught the rudiments of handling motors and the requirements of installation—in other words, who have been taught the limitations of electrical motors, so that they do not get us into continual trouble with the customers through over-promising. However, there is one point where the manufacturers do get us into serious trouble with the customers in regard to A. C. motors. In the last two weeks I have had three cases of considerable friction, which will probably be amicably adjusted, but which means quite an expense to our company owing to the fact that there was no standard speed quoted for the A. C. motors by the salesmen of the manufacturing company. One company quotes the no-load speed; another company quotes the speed with a standard assumed slip; another company still quotes the speed with about ten per cent. less than the standard assumed slip. In other words, the speed of the motor was given ten per cent. slower than it would actually run under full load, and this is the cause of considerable trouble to the man who takes it for granted there is a certain speed in a certain motor because the salesman gave him that speed. The minute that machine is put into practical operation it drops down between six and seven per cent., and as all the appliances are ordered for that speed, it is the cause of much complaint. These may seem small things to the manufacturer, but it is those things that make trouble for the commercial departments of the central station companies.

I notice in giving the figures on page 3, he deducts $20 for depreciation, interest and repairs, on a $100 motor. I would like to ask Mr. Scott whether 20 per cent. is the figure he recognizes for general use? In other words, if his experience is that they require such a percentage as that shows.

I wish to express my personal appreciation and thanks to Mr. Scott for this excellent paper, which will be of so much help to all our commercial men.

Mr. Baker: In connection with co-operation between the manufacturer and the power company there might be one or two influences that tend to keep it back. One is that engineers and salesmen have a tendency to argue that their apparatus is perfect, and the power company is backward about appreciating certain delays between the time of their turning in complaints on the apparatus and when the manufacturer gives his report on such complaints. Another thing on the part of the power company which tends against co-operation is that at the very time that co-operation is necessary, that is the time that the apparatus is in trouble. The power company wishes to keep such trouble as secret as possible because it may reflect on the operation of the power company itself, and does not communicate the trouble to the manufacturers. In certain cases of trouble the advancement of the

apparatus might be carried on better by the power company itself taking the apparatus as it comes from the manufacturer and actually by its own operations producing certain improvements on it. In that case it does not have to tell its secrets to outsiders.

A Member: Mr. Chairman and fellow members: I think we are very much indebted to Mr. Scott for this paper. It is the kind of paper we all like to hear in our conventions. There is one point I would like to mention, and that is that there are some manufacturers who keep a number of trained engineers, and in the last two or three months I have seen one or two cases where their work has been of great advantage to both the power company and the user. I know of a case of a salesman not very far from here where they sent pretty fair information as they considered, but they didn't give us all the information such as the contract required. This contract was drawn up so that they were on the peak load for a very few seconds during the month, and we, not knowing that, put the appliances in for normal operation, and when they went to pay their bills they found they were paying for more power than they thought they were using. If they had given us all the information it would have been much more satisfactory to all concerned. Another point is that these salesmen are anxious to get the orders closed up, and they do not always get at the bottom of the engineering points as regards all the details, and I think it is absolutely necessary if it is a big job to insist that an engineer on the ground be supplied.

Mr. Scott: Mr. President, with regard to the matter of coil wound rotors, I do not think the point can be answered by yes or no as to which rotor it is best to use. From the standpoint of the customer, there is something in the simplicity of the squirrel cage rotor. The system of starting a motor that blows out the circuit breaker at the central station or sub-station is certainly wrong. Theoretically the motor should be protected locally in such a way that any excess current will open the circuit at the motor itself. If, however, the conditions do demand a motor with a wound rotor and it is not available, then a case has arisen which should be taken up with the manufacturer and which calls for the sort of co-operation which I have been talking about. I heartily agree with what has been said about the lamps. The average citizen considers very carefully whether he shall pay 25 cents or 20 cents for a lamp—in fact, he is apt to pay a great deal more attention to that five cents than he does to the $3 or $4 worth of current that that lamp uses up during its life.

In the matter of standardization, I sometimes talk on one side and sometimes the other. When those in connection with manufacturing companies say we don't want to make any special apparatus and that a man ought always to buy what is standard, I say not always. It is important to pick out the new kinds of so-called special apparatus or new apparatus which is needed to meet new conditions. It is just as important that we recognize and do all we can, as manufacturers, to meet the demand for five or ten per cent. of these special things, as it is in the

interests of all not to design and manufacture the other ninety per cent. We want to use standard things where the experience of the past justifies us in believing that that is the right thing to do and is good enough for the present, but we don't want to stop there, we have got to go on. This old story about those poor patterns and dies that the manufacturers don't want to throw away—why, they are wearing out all the time; they have to make new ones anyway. If you think they are holding onto these old things, just take the electrical catalogues which are about four or five years old, and compare them with the catalogues now, and you will see that practically everything that the manufacturers make is new. I believe the manufacturing companies of this country have spent several million dollars during the past year in their development work in trying to make new and better apparatus. Take motors or transformers, and one company gets out a new line a little better and then the other. You can hardly keep track of the new kinds of motors and new kinds of meters and the new kinds of controlling devices, and so on. They are advancing all the time, but for goodness' sake, if the thing is good enough let us leave it alone, but if not, let us make something better.

With reference to the matter that the President spoke about of the manufacturing companies loaning men who could go and assist in this kind of work, I may say this is good practice and has been carried on successfully, and I think to the mutual advantage of both the manufacturer and the central station in a number of cases. The point of the training of the young men by the manufacturing company has been well recognized by one of the speakers. That is very useful to the central station.

One point occurred to me during the discussion. If you have a man who is running a mill or a shop in your community, and you want to get him educated, one way would be to send to a manufacturer and get a bulletin describing an installation in a similar plant elsewhere, or send for a copy of the "Electrical World" or other paper, which has a description of something in which he would be interested. Get him to see that he is getting behind the times and is not up to people elsewhere unless he uses electric drive.

With regard to steam heating, I believe down in Rochester they are entering into an investigation of how the isolated plants around the city, the plants in the various office buildings, and so on, could all be operated in connection with a big central station plant as a common system. For example, the electric plant in a given building might be operated for a little time during the peak load, and then the other parts of the day the lighter load could be carried from the central station, or the various isolated plants throughout the city could feed back into the general city mains when necessary. I know that steam heating from a central station is done in some places, although I cannot at the moment give details of it.

The figure of \$20 as the annual cost of a motor I took merely as a round figure which nobody would dispute, or if they did dispute it, they would say it is too high, and it would prove my proposition all the better. It would seem to me for an average motor it is quite too high and could be reduced.

With regard again to co-operation between the central station and the manufacturer, a point was called to my attention in talking to one of the members this morning. He said if they are going to co-operate they must be within co-operating distance. If anything serious happens the central station wants to be in close touch with the manufacturer so that it can get the repairs quickly. I believe some cases have come up in which very much quicker co-operation has been gotten from manufacturers who were within a thousand miles than could be gotten from manufacturers on the other side of the ocean.

One other point. If you are going to run your plant right you must have good apparatus. If there is a burn-out or a shut-down people do not go back to ask where that apparatus came from, but they put the blame on the man that runs the dynamo, or upon the superintendent. It may be that they came by the apparatus because the purchasing agent saved \$5 or \$100 a year or two before in getting something which the engineer did not want and recommended against. It is the man that runs the apparatus who is going to get the blame for trouble, and if he is wise he will do all he can at the start to get the right apparatus to run.

The President: The next paper is one by Mr. T. F. Kelly, of the Hamilton Electric Light & Power Company, on ''Ornamental Street Lighting.''

ORNAMENTAL STREET LIGHTING

By T. F. Kelly

Hamilton Electric Light and Power Co.

Knowing that the Commercial Committee of the National Electric Light Association, with which this association is now affiliated, has appointed a committee on Ornamental Street Lighting to prepare a report to be read at the convention of that association in New York, May 29th to June 3rd of this year, and that we as members of that association will soon see copies of that report, which will no doubt cover the subject of this paper very fully, I will not attempt to explain such installations throughout the United States, but will endeavor to give you some information regarding similar systems in Canada, and Hamilton, Ontario, in particular.

New Westminster, Vancouver and Victoria in British Columbia, St. Catharines, Fort William, Ottawa and Hamilton in Ontario, were the only cities in Canada where ornamental electric standards equipped with tungsten lamps have been installed and operated at the time this paper was prepared. Other installations in Toronto, Ont., Calgary, Alberta, and some of the towns in the hydro-electric zone in Western Ontario, had their systems installed but not in operation, and I was unable to get any information regarding them.

Such systems of ornamental street lighting I believe to be an improvement over other so-called ornamental installations such as the arc and festoon lighting, particularly on account of the results obtained from the illuminating standpoint, because from such installations a wonderfully even distribution of light is obtained. Other arguments in favor of such systems are the low installation and maintenance cost, but perhaps the greatest is its permanency and being ornamental by day as well as by night.

The majority of the standards installed have five lamps, yet some have three, and at Fort William, Ontario, ornamental combined trolley and lighting standards have been installed carrying four lamps, giving wonderful results as to low maintenance cost and from the illuminating standpoint.

The standards installed at Hamilton consist of four side lamps burning pendant and the centre upright, whereas I understand all the lamps on the standards in Minneapolis and many other American cities are upright. Which is the most preferable of these systems has been debated, yet the most popular one in Canada is such as we have installed at Hamilton, and which, I think, is by far superior to any other.

This particular system of street lighting is not altogether new, yet it is only within the last two years that any great progress has been made, but now almost every city in the Dominion has become interested. One cannot help noting the hold this class of lighting has on cities and towns conducting their own municipal street lighting plants, such as Toronto, Ottawa, London and Waterloo in Ontario; and Calgary in Alberta, and it would lead one to believe that the arc lamp for street lighting is slowly but surely passing out of existence, except, perhaps, for cities with exceptionally wide avenues, where it is more than likely the magnetite arc lamp on ornamental iron poles will be the unit in use. Such an installation, I understand, the city of Winnipeg has decided to install upon their two wide avenues of 132 feet, namely, Main street and Portage avenue. These units will be ornamental iron poles each carrying two 6.6 ampere magnetite arc lamps with Alba globes in the business district, while the outlying districts will have suitable iron standards with one lamp. The posts carrying the two lamps will be approximately 160 feet apart. The system will be installed and maintained by the city, although it has been decided that where the extra lighting is to be installed the merchants and property owners will pay a proportion of the cost.

The Festoon System

While perhaps the oldest system of what might be termed an ornamental street lighting system is the festoon or arch system, and a number of such installations are in the States of Michigan and Indiana and quite close to the border, I have never heard of such an installation being contemplated in Canada, and, as I understand, many cities having such installations are abandoning them for the more permanent system, we in Canada seem to have looked far enough ahead to realize that such installations were not by any means permanent, and therefore did not follow the lead of our friends across the border and attempt similar installations here.

The great objection to this festoon or arch system of lighting appears to be its look of being temporary as if for a carnival, and its high maintenance cost.

The installations of ornamental electric standards with tungsten lamps regarding which I was able to secure any data are as follows:

British Columbia Installations

The British Columbia Electric Railway Company have an installation of 39 three-light standards on Beach avenue, Vancouver, B.C. These standards are about 100 feet apart, and the street thus illuminated extends 2,360 feet. For 1,460 feet, standards are on both sides, and on the remainder, on one side only. These standards are equipped with three 55 watt Osram tungsten lamps of 110

volts, in 8-inch opalescent spherical globes, and are connected to overhead system by leads being brought down transformer pole in conduit to underground ducts. Their standards are turned on and off by watchmen and burn on all-night schedule. The city authorities pay for the installation, lighting and maintenance cost of this system.

The same company have one other installation at the present time in Vancouver, and two others, one in New Westminster and the other in Victoria.

The Granville street, in Vancouver, installation consists of 113 five-light standards about 100 feet apart, extending 5,600 feet on both sides of the street. The standards are equipped with five 6.5 ampere series tungsten lamps connected in multiple at 11.3 volts. The service supplying the lighting is 110-220 volts, 3-wire, each service supplying about twelve posts on two circuits. Leads are brought in conduit down the pole to underground ducts. The lamps on each standard are wired in multiple with switch and transformer inside each standard. The top lamp is in a 16-inch opal globe, and the side lamps in 14-inch spherical opalescent. The lamps burn on all-night schedule and are controlled by time switch on service poles. This particular installation was installed at the expense of the property owners and the city pays for the lighting and maintenance of same.

The ornamental street lighting in Victoria, B.C., at the present time extends approximately 3,200 feet, there being 80 five-light standards equipped with 50 watt, 8 volt tungsten lamps in 12 and 14 inch round frosted globes about 80 feet apart. The current for this lighting is supplied by the British Columbia Electric Railway to city lighting station at 2,000 volts a.c., thence by overhead to centre of distribution, thence by underground to transformers located in manholes, thence 110 volts to distributing fuse blocks, one for each post, thence to post transformers reducing to 8 volts, thence to lamps. Yates and Douglass streets are thus illuminated every night; all the lamps burn until midnight and then alternate standards with standards at diagonal corners. The city pays for the current consumed at a very low meter rate.

The New Westminster installation was installed and is maintained and lighted at the expense of the city. The system consists of something like 105 five-light standards placed 66 feet apart, each standard being equipped with five 50 watt 7.5 amp. series tungstens giving about 200 c.p. per standard.

Ornamental Standards at Fort William

The municipal lighting department of Fort William have installed some ornamental lighting standards; May street is illuminated for a distance of 400 feet with 17 standards about 50 feet apart. Five-light standards are at street corners and three-light standards

between, all being equipped with 100 watt multiple tungsten lamps. Victoria street is illuminated 1,400 feet by 28 combination lamp and trolley standards 100 feet apart equipped with four 6.6 ampere series tungsten lamps in series with street arcs. These lamps are all enclosed in 14 and 16 inch Alba globes and are burned on all-night schedule, being controlled from substation. Both these installations were installed by the property owners benefited paying for same on a frontage basis and the city supplies the lighting and maintains the systems.

The Hamilton "White Way"

Regarding the installation in Hamilton we have 58 five light standards on King and James streets illuminating in all about 2,262 feet with standards about 40 to 45 feet apart. The standards are located one at each street corner and others spaced at equal distances between to obtain as nearly as possible the uniform spacing of 45 feet. Each standard is equipped with four 75 and one 100 candle power multiple Canadian Tungsten lamps in 12 and 16 inch "Polycase" globes.

The circuits for these standards are run from transformer situated in the centre of each block. The circuits contain three wires and run down the transformer pole in conduit to the nearest standard and from there distributed to the different standards in that particular block in conduit placed about three inches below the surface of the pavement near the curb. The lamps of each block are controlled by switch placed in the base of the standard nearest to the transformer pole and this lighting is switched on and off by patrolmen. Standards are illuminated from dark until 11 p.m., although the standards were wired three-wire to permit of the top lamp being burned all night should the city council at any time wish to contract for this extra lighting. Our standards are painted a bronze green at least once a year. I would have liked to have given the members exact information as to cost of lamp and globe renewals per year but am unable to. However, I believe from our experience one lamp renewal per year is a fair estimate. Regarding the globes, would not care to make an estimate, but they are at a minimum.

This system was installed and is maintained by the company. Merchants and property owners benefited pay for this service at the rate of 12½ cents net per foot frontage per month, depending on the frontage of their store or property. Each merchant or property owner pays for his frontage in block illuminated whether or not the standard was placed in front of his store or property.

The standards selected in Hamilton were made of pressed steel. This patented invention makes the construction of a tapered, fluted column or support from sheet metal a possibility for the first time,

and lends itself admirably to the manufacture of lamp standards requiring classical lines and clear-cut, graceful contours. A sheet of steel of sufficient gauge to insure perfect strength is formed into a plain tapered column of proper architectural proportions. Another plain column of same size and shape, constructed of special non-oxidizing steel, is forced inside of the first. By means of patented machinery the double tapered column is then fluted in accordance with either the Doric or Corinthian orders of architecture. The double thickness of material, together with fluting, increases by several times both compression and lateral strength. Double thickness No. 22 gauge high carbon, non-oxidizing steel is employed in the manufacture of these standards. This construction carries with it sufficient strength for all purposes, yet does away with heavy shipping charges and great weight and difficulty in erecting the standards.

In Hamilton after deciding upon the rate to be secured for this service, we were interviewed by the city newspaper men and secured an immense amount of publicity by setting forth to these men the plans of the company to give Hamilton an electric "white way" and by showing them what other cities were doing and by telling what we would do if we received the support of the merchants and property owners along the streets selected to become Hamilton's "white way." Then our canvassing started and in less than one month we had five year contracts closed with the merchants and property owners of four blocks. This, I can assure you, required some hustling, but with the "boosting" from the newspapers and having the merchants of one block competing with another as to who would have the standards up first we were thus successful. From my experience I believe the store to store canvass the most satisfactory and quickest way to secure business of this nature. The first block illuminated in Hamilton I secured in this manner, beating out another block where I had endeavored to secure the business by a meeting of merchants interested.

While we are being paid for this service through the merchants and property owners benefited, perhaps the most successful way to undertake such an installation is to endeavor to get the merchants and property owners to pay the cost of installing the system and for the city to pay for the lighting. Still another way is to have the city install light and maintain the system, taxing the property owners thus benefited a portion of the cost of the extra lighting.

While the citizens of Hamilton may have appreciated our efforts to give the city good service, the movement for the "white way" was no doubt the most popular move we had made up to that time. Not only have the citizens at large been favorably impressed by the great improvement which this ornamental lighting system made in the appearance of the city, but the merchants themselves soon began to realize as they had never before that lighting

attracts trade, with the result that the system being installed meant increased revenue from interior and window lighting, and now, I believe, the shopping district of Hamilton will compare most favorably with any city of its size on the continent and many large ones as to illumination and metropolitan activity.

DISCUSSION.

Mr. Pack: Mr. Kelly has given us a very interesting description of several street lighting systems. I wish he had been able to give us more particulars as to the cost of maintenance of these systems. It would be interesting, for instance, to know the cost of lamp renewals and cleaning.

I was interested to hear that in Hamilton they have arranged for the top lamp, in a cluster of five, to be left burning all night if the city should so desire it. I believe this is a common practice in the cities in the States, and it is often possible to arrange for the city authorities to pay for the cost of the lighting, or current supplied to, this one lamp.

I believe some of us, at one time, thought that increasing the illumination in the city streets would have a tendency to spoil the effect of sign lighting and window lighting, but experience has proved that where the streets are brilliantly illuminated the merchants have been compelled to use a greater amount of light in their windows, and increase the brilliancy of their signs. The effect, therefore, has been to much increase the consumption of current by the stores themselves.

Mr. Lambe: In connection with street standards, it has often struck me that the putting up of these standards is an entirely wrong procedure, and a great economic waste, where you have iron trolley poles on which the lights could be mounted. Of course, I know there are franchise objections, etc., but nevertheless the proper thing to do is to have a two or four-arm casting, bolt it to the trolley pole, and put the lights there. Mr. Beman doubtless can give us some information as to the life of tungstens when so mounted. Then Mr. Kelly spoke of collecting from people who had run into the poles and had broken globes. I was just wondering if that means that the standards were placed so that the hub of a wagon would strike them.

Mr. Kelly: It is more likely to be a load of hay. It is just in case of carelessness.

Mr. Lambe: Unless it is pure carelessness, I should think it would give you a bad reputation to render a bill in such a case, as people will say that it was as much your fault as theirs for putting your lamp where it could be struck by a passing vehicle. The city of Ottawa, where they have put up five-light standards 65 feet apart, is charging its consumers five cents per foot frontage per month, I think it is, which charge is intended to cover installation, renewals, and so on, as I understand it. If, Mr. Chairman, you care to give us your opinion as to the sufficiency

of this figure, I am sure the meeting would be most interested in hearing from you.

The President: In the ornamental lighting on Sparks street, which was the first street undertaken, we followed the same plan as Mr. Kelly has described. A canvass of the merchants was made which took us more than three months, owing to the absence of some of the owners of the buildings, and so forth. However, we secured the whole business section of the street on three-year contracts at ten cents per foot frontage. We had to ask the city's permission to erect the standards, and when we did that, they refused. They said, we will do this ourselves, and they carried out the plan that we had outlined, and they did it for half the money. Whether they are going to lose money or not I am not able to say. Our basis of calculation was to pay for the lighting and the maintenance, and a certain amount which would gradually wipe out the investment. The item of maintenance, of course, was largely a matter of guess, as we did not have much data to work on. They expect to do it for five cents, but they didn't make contracts with the citizens. They are now extending it and putting it through under what is called ''local improvement by-laws,'' whereby the property owner is taxed a proportion of the cost, and the city pays a proportion, so that it is not optional with the merchant. If the majority of the ratepayers on a street holding a certain percentage of the assessed value ask for this thing, then the others must submit and pay the tax for it. We thought we would be given credit for originating the idea, but to my great surprise when the matter was brought up before the Board of Control the Mayor stated that he had thought it out beforehand, and it was his scheme.

Mr. McNabb: I would like to ask Mr. Kelly if he has been successful in cases where the city would not pay a proportion of the light, in getting the merchants themselves to instal the poles? What I am trying to find out is, if you have a street lined up for lighting to be paid for entirely by the merchants, and if so, what kind of a contract did you make with them, and what kind of an arrangement did you make in case the consumer went out of business and the pole is still left there? How do you take care of that part of it? Do you just suffer the loss, or is that taken care of in some other way?

Mr. Black: Ornamental street lighting systems consisting of iron pillars with tungsten clusters of three or four lights, fed by an underground circuit, is not by any means the most economical form of lighting, but it seems to me it has very many advantages. First, it is along the line of what the public want, and it is ornamental. Second, if your circuit cuts off, no auxiliary apparatus has to be maintained or started up, and consequently you get the street lighting going very much sooner than if you have some form of arc lighting system consisting of a series circuit. Thirdly, the system is formed of multiple circuits, and the same system of underground mains which supply the light and power may be used for the street lighting. It seems to me that this is very

important inasmuch as I think the time is fast coming when in the central portions of our large cities all our wires will have to be underground. In a great many cases this means direct current circuits which will supply the entire demand in the district, all being fed from one set of mains. This system of tungsten lighting also has the advantage that it can be supplemented by a storage battery so that you can practically count on a continuous service. It has the additional advantage over a series circuit, or any form of circuit of that kind, that the lights will go out individually instead of the whole circuit cutting out at once. While this system is not by any means the most economical from the operating point of view, it has very many points to commend it.

Mr. Beman: I have a digest of about sixty-eight installations of ornamental street lighting in Canada and the United States, and these figures will perhaps assist in answering some of the questions. One thing is noticeable, that is the general adaptability of the system. It is found in towns as small as 615 and cities of over 2,000,000. The standards usually run from two and three, to five lights, with a great preponderance with five lights. Hamilton is the only place using as large a lamp as 125 watts. The multiple lamp is used more than the series lamp. I don't necessarily mean a series circuit, because sometimes all the lamps of one standard are connected in series to a multiple distributing system. Many standards run till 12 o'clock with one lamp running all night. The total number of posts of which I have record is between five and six thousand. The city maintains somewhat less than half of this number, the rest being maintained by merchants or property owners, and in some cases the tenants. As to the form of contract under those circumstances I have no information. The amount paid per standard varies greatly. The yearly cost is usually from about \$55 to \$85 per standard. As to the practice of putting lamps on the trolley poles, that was one feature brought up at the National Electric Light Convention in New York, and the speaker said he would unqualifiedly recommend their use on trolley posts; that they had no trouble whatever.

Some idea of how things are tending can be gained from a recent experience in a town of 8,000 where they put in eighty-six standards, and the people were so much interested they had a big celebration and procession, and the Electric Light Company was so confident they would never go back to the arc lighting that they had a float with a label reading on one side "Gone for sure," and on the other side, "Dead ones."

Mr. Kemble: I would suggest that Mr. Beman contribute a summary as an appendix to his paper of the figures he has referred to, as it would be very useful to all of us.

Mr. Beman: Certainly.

TABLE COMPILED FROM DATA ON ORNAMENTAL LIGHTING.
Installations of 51 Cities.
(Contributed to the Convention Proceedings by Mr. Beman.)

		No. of installations.	Remarks.
Population	Below 10,000	10	Ornamental installation not limited to large cities.
	10,000 to 100,000	31	
	Above 100,000	10	
Type of Standard	3 light	9	Predominance of 5 light standard.
	5 light	30	
	3 and 5 light	5	
	Other	7	
Size of lamps.	40 watt	9	60 and 100 watt lamps used in most cases.
	60 watt	25	
	75 watt	2	
	100 watt	26	
	125 watt	1	
System of wiring	Multiple	31	Multiple system general
	Series	4	
Schedule of burning	All night	4	Mostly on mixed schedule.
	Less than all night	13	
	Mixed	20	
Installed by	City or Lighting Co.	8	Property owners pay for installation.
	Owners or tenants	21	
	Divided	2	
Maintained by	City	10	Maintenance often taken care of by city.
	Owners or tenants	14	
	Divided	2	
Average spacing	75 feet		
Reported cost of installation	From about $60 to $120.		Note.—The cost of installation varies considerably, due largely to the difference in cost of ornamental standards and the construction work required in laying the wiring system.
Maintenance cost	Mixed schedule		5 light. $50 to $90 per post year.
	60 and 100 watt lamps		3 light. $30 to $60 per post year.

Mr. MacLachlan: The iron standard as we have it to-day applies more, as I regard it, to cities of ten or fifteen thousand and upwards. I would like to hear from some of the smaller companies if they have any other form of ornamental lighting. I don't mean the festoon light-

ing, but along the line of concrete posts with one standard, that would be adaptable to the smaller cities.

Mr. Scott: Mr. Chairman, one point about this lighting struck me—it is a different kind of lighting. Most of us judge of the effect of illumination, not by looking at the thing that should be lighted, but by looking at the lamp itself. We are used to bright spot lighting in the arc lighting of the streets. A short time ago I was in Philadelphia and in the evening I walked down to the public square around the City Hall where there are ornamental lamp posts. Everything there is on a large scale. The posts have one top lamp and one encircling row a little lower, and then another row a little lower still, making quite a number of lamps on each post, yet with the large number of lamps my first thought was that it was very ornamental but it wasn't giving much light. I was disappointed. That was my first impression as a citizen. I then began as an illumination engineer to study the question, and I looked to see why it wasn't good light, and I found it was something like daylight. I looked about at the building and at the people, and I saw there was a good general uniform illumination without the intensity in certain spots that we are used to. I found a young fellow sitting down reading a newspaper I suppose twenty-five feet from a lamp post, and he seemed to be getting on very comfortably. Now, I think the new kind of illumination, by the new lamp, is bringing in a new kind of light as well as a new type of service.

Mr. Kelly: Regarding the maintenance cost, I may say in Hamilton that the top lamp is not burning at the present time on account of local conditions. As many of you know, in Hamilton we are not on quite as friendly terms as we might be with our City Council because of the dealings with the Hydro-Electric Commission, and we haven't gone to the city regarding getting that particular contract, but the street arc lights are still burning in addition to the ornamental post lighting. The business of sign and window lighting has positively increased in Hamilton. In the N.E.L.A. Convention at New York some of the members stated that they hadn't been able to get that business since the ornamental street lighting came into effect, but that is not so in Hamilton, as it has increased since the standards were installed. In regard to the trolley standards, I wrote to the manager at Fort William, and the answer I got was that they were quite satisfactory, as compared with the other standards.

The globe breakages are practically at a minimum. I simply mentioned the fact that there were some broken by neglectful painters, and the bill was sent to them and we were able to collect without any trouble.

With regard to Mr. McNabb's question, I would say that the majority of our contracts are with the property owners who own the stores and occupy them, and in some cases with the property owners who are not occupying them. Now, there are instances in Hamilton where we have no security regarding the new tenant. In the case of a

merchant moving out and another man moving in, we have nothing to really protect us. We have had such instances crop up, but we have had no trouble except in one instance in getting a contract from the succeeding merchant. Even with a Jap who came along to occupy a store during the winter months, we had no trouble in securing a contract with him, although there wasn't a standard in front of his store. He paid us for a frontage of something like twenty-five feet and it amounted to about $3 a month. He realized the value of the street being illuminated with standards. I asked him if there was a block with standards and one without, which block he would go to, and he said the one with the standards. People are recognizing the benefit of increased illumination.

Mr. Pratt: In supplementing Mr. Kelly's very able remarks on the subject of ornamental street lighting, I have no doubt that many of you are interested in or contemplating installing ornamental standards, and that will be my excuse for taking up your time. The question of maintenance is a very important one, and I am sorry that at the present time we are not able to give you very definite figures, for the reason that our standards were not all installed at the same time. However, Mr. Kelly's statement that one lamp renewal per year will take care of the lamp renewals is just about right. In any event it will not exceed one and one-half lamps per year per standard. The question of globes is a very important one. Our experience is that the cost of maintaining the globes is higher, if anything, than the cost of maintaining the lamps. In the first place we adopted rough inside globes. This I think was a mistake, and we are changing them as fast as they break. We found it reduced the mechanical strength of the globe about one-half, and not only that, they collect the dust, which appears to burn into the glass and is difficult of removal. The first globe we tried was one with the collar moulded onto the body of the globe, and the result was with the extremes of temperature they broke at the point of contact where the flange and the globe were joined. Then we tried a heavier frosted globe, but if the screws were tightened too much the expansion also caused them to break. We then considered one which was smooth on both sides. Of course, standing here, I do not wish to advocate any particular make of globe. We tried the Alba globe with very satisfactory results. We found it from an illuminating standpoint very efficient, but in our case where the cost of production of current is low and the posts close together and using very high candle power lamps, Hamilton being the only place where 125 watt lamps are used, we found we could afford to use a globe which was more ornamental but less efficient, so we adopted an opal globe, which is the least efficient in light giving quality of the four types that we tried. The Alba globe outlined the filament. With the opal globe the diffusion was exceptionally good and it showed up better in contrast to the green posts in the day time. With regard to the breakages, most of the difficulty was caused by the inexperience of the men in cleaning

them, and we finally adopted methods which have reduced that to a minimum. We equipped a dray with special boxes and padded a bath tub, into which we put the globes for cleaning. We used some heavy woollen horse blankets for padding.

As Mr. Kelly said, there is no doubt about it that the use of the standards has raised the standard of illumination in Hamilton to a very large extent, and I am in a position to say positively that it has resulted in a very large increase in business lighting where the standards are in operation.

The President: I am sure we are all indebted to Mr. Kelly for this paper. Data in this regard has been very scarce and scattered, and he has collected it in a way which is very valuable. Before proceeding with the Report of the Committee on the Standardization of Line Construction, there is a little ceremony to take place which I would like you all to witness. I would ask Mr. Adams to come on the platform. (Mr. Adams comes forward.)

Mr. Kemble: There are two classes of men on whom the success of a Convention depends. One class sits on the platform, and is in the lime-light of publicity and gets due appreciation for all the hard work they do. The other class is not in the lime-light, does not sit on the platform unless forced there, and yet works just as hard as it knows how for six months before the Convention takes place.

To one man is due a great deal of the credit for the success of the Convention which we have enjoyed and which closes this afternoon. I refer to the Chairman of the Convention Committee and the Entertainment Committee, whose work has been unremitting and unlimited by the hours of the day. Gentlemen, I wish to move a vote of appreciation to Mr. W. L. Adams, the Chairman of those two committees.

Mr. Pack: Mr. Chairman, it gives me very great pleasure indeed to second this resolution. It seems hardly necessary to second it, because I believe that every man, woman and child who has attended this Convention is seconding the motion every hour of the day. Mr. Adams handled this feature of the Convention to perfection. The service has been practically continuous, and while yesterday, as we all know, he had a very high peak load to handle, even then the service did not fall down. Speaking for the members of my own company who have come here in large numbers, I should like to say that there wasn't a man or a woman who came from Toronto who did not have a first-class time. Now, this means that yesterday one hundred and forty-two extra people were turned over to Mr. Adams' care, and as I said before, he was quite equal to the occasion. As Mr. Kemble has so well said, Mr. Adams is noted amongst other things for his very extreme modesty, and in no way has he been identified publicly with the entertainment features, but he has been constantly in the background directing everything that has taken place, and we have felt the silent influence of Mr. Adams all around us. I have very much pleasure in seconding the resolution.

The President: I take this motion of thanks and appreciation on the part of the Association to Mr. Adams to include as well the members of his Committee.

The President put the motion, which on a vote being taken, was carried, with applause.

Mr. Adams: Mr. President and gentlemen, I thank you for your kind expressions that you have tendered to me with reference to the influence of the Committee and myself. I do not think we have overworked ourselves. We have tried to fill in the time between the peaks, and tried to carry on the thing with a fairly high load factor, and if you have appreciated what we have done, we are more than repaid for our efforts. Gentlemen, on behalf of the Committee I thank you very much. We appreciate what Mr. Kemble and Mr. Pack have said.

Mr. Adams was given three cheers and a tiger.

Mr. Kemble: I think it is now in order to move a vote of thanks to the other Committees, the Ladies' Committee especially, and to the Traction Company, and the others who have been so generous in giving time and service in order to make this Convention a success.

Mr. Pack: I second that.

The President put the motion, which on a vote being taken, was carried.

The President: The next item is the report of the "Committee on Standardization of Line Construction," and Mr. Black will present his report.

Mr. Black: At the start I would say that we have no written report to present. We considered the matter very carefully to see what procedure we should take, and we waited until the final report was made by the Committee appointed by the National Electric Light Association before deciding. This Committee of the National Electric Light Association is composed of some of the best operating men in the United States and they have worked on this report, a copy of which I hold in my hand, for three years. It took them that time to finally bring in their report. I was at the Convention where this report was presented, and Mr. Osgoode, the Chairman, said they had held a great many sessions and had interviewed a great many different people before arriving at the conclusions which they finally put in their report, and in view of the nature and completeness of their report we decided that it would be rather presumptuous for us to attempt to bring in any report at all, because it would either be conflicting with this one, or practically reiterating what was in it. We thought it would not in any way be as complete as this one, and you will each get copies of it. The N.E.L.A. report consists of four different parts: first, specifications for a twenty-three hundred volt line work and the work under those general specifications. There are special specifications for material such as wooden poles, wooden cross-arms, cross-arm braces, wooden pins, metal pins, guy wire, guy rods, copper wire, aluminum wire, and so on. It embodies a lot of detailed specifications. The next sub-division is secondary dis-

tribution, and the report gives detailed specifications in conection with this. It is illustrated with pictures and cuts, diagrams and tables. The next section they take up is the relation of different companies on the same poles, and how the wires should be arranged, and what rights each company should have. The fourth division relates to crossings, for example, such as railroad crossings. The Committee has gone into that very, very fully, and Mr. Osgoode in bringing in the report said he was not bringing it in for discussion or for alteration, that they had worked on the report for three years and they brought it in to be adopted. They were, he said, prepared to answer any question that any person would ask them to justify the statements made in the report. He stated in a great many cases the results were not determined on until they had had conferences with companies, such as telephone companies, telegraph companies and street railway companies, and their opinions therein contained were the best compromises they could make, and they very strongly recommended it should be adopted throughout the United States, for many reasons, one reason being that it would simplify the work for the linemen and the construction would be uniformly good and uniformly safe. Then it would simplify things for the manufacturers, inasmuch as they would be able to stock cross-arms, braces and other line material, and not have to have specifications from each company. Now, in Canada each company seems to have adopted its own standard, and have not been very particular about the specifications. I think the time has come when we should all pay a great deal more attention to our line work. In the first place, public opinion demands it, and public safety demands it. The report does not take into consideration power transmission work, but merely takes in the twenty-three hundred volt work, the opinion of the Committee being that transmission work required special consideration and could not very well be standardized. For voltages over twenty-three hundred between each phase wire and the neutral it was the opinion of the Committee that wires of that sort should be placed underground, as it was dangerous in cities carrying lines of 12,000 volts and over.

I have managed to get from one of the operating companies the dimensions of these cross-arms, and I have here a blue print which any of you can see. I have also got three folders showing some special arrangements that some of the operating companies got up for steel bracket work on poles. We have been in the habit of using too many cross-arms, and it is found by making special arrangements in the way of iron brackets that very much neater pole work can be done. It is strongly recommended that all the companies after they get this report look over the specifications and the pictures of poles and get out a set of blue prints for their line department whereby all the poles will be made to standard as far as possible. A great improvement could be made on our line construction if we could reduce it down to a set of blue prints whereby every piece of work which is similar to another piece of work can be done according to the same sketch, which can

be given to the linemen. I may say if any person is interested in getting copies of this blue print that the tracings are in Toronto, and if any person would write me I would take pleasure in sending them copies of the prints. These are not shown as the ideal way of doing it, but merely the way that one company is doing these things.

Now, that is all we have to report. When you get this volume you will find it very, very valuable, and we thought it unwise to practically give you the same information in different form.

Mr. Murphy: Will Mr. Black be good enough to say a word in regard to the specifications for railway crossings. Do they vary materially from the rules laid down by the Railway Commissioners for the Dominion of Canada?

Mr. Black: With reference to the specifications which the Committee adopted, they are practically the same as the preliminary copies which were sent around. I understand it is somewhat different from that adopted by the Dominion Railway Board, but are substantially as good although differing in detail.

The President: I take it that if this Association should adopt those rules they would have to be subrogated to the regulations of the Railway Commission. There is no doubt we will have to conform to the ruling of the Railway Commission, and where the rules clash the rules of the Railway Commission would have to prevail.

I might say that in New York they did not adopt the report definitely. There was one point raised there with reference to the distance between the wires of two different companies. Under certain conditions the minimum distance was put at some fifteen inches, and one man said in his city they had arrangements with other companies whereby they were not to be any closer than three feet, and if this was adopted as the standard of the Association those people might demand that they be allowed to come within fifteen inches. On the whole it was thought most desirable to have some standards adopted so that when construction was criticized we could fall back on the Association.

Is it your idea that the Association should take some action?

Mr. Black: I do not think it is necessary to take any particular action. I think it would be wise for each company when they get this report to study it very carefully and as far as possible adopt it, without the Association passing any resolution.

The President: I understand it is the wish of the Committee that we should follow these specifications?

Mr. Black: We think it would be wise, and we recommend it.

The President: We will decide this afternoon what committees should be appointed for the coming year.

The Convention then adjourned till the afternoon.

AFTERNOON SESSION.

At 2.30 p.m. the President called the meeting to order and asked Mr. C. E. Allen, of the Westinghouse Electric & Manufacturing Co., of Pittsburg, to read his paper on "The Importance of the Use of Potential Regulators on Distributing Systems."

THE IMPORTANCE OF THE USE OF POTENTIAL FEEDER REGULATORS ON DISTRIBUTING SYSTEMS.

C. E. Allen.

There is probably no class of electrical apparatus of more importance to the modern alternating current central station than the potential feeder regulator. While the demand for such a regulator has existed since the time of the earliest use of large generating apparatus supplying power to more than one feeder, yet only within recent years has the potential feeder regulator been developed to the degree of satisfaction that would justify its use by all central stations having more than one feeder supplied from this same generating equipment.

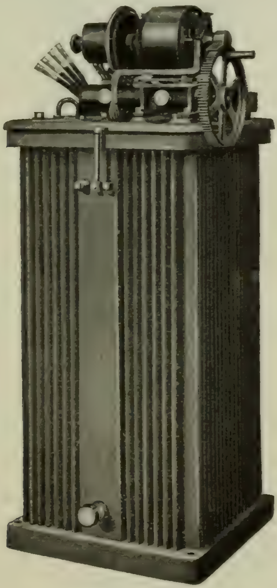


Fig. 1.

The demand for such regulators has been further augmented by keen competition, which necessitates greater economy of operation, and the education of the public, who require considerably better service to-day than they did a few years ago.

This demand was first met by the step by step type regulator operated by hand. It was later found desirable to operate these regulators by remote control of the motor, so that the switchboard attendant would be able to more readily control the regulators from one central point. While the step-by-step type regulator was quite satisfactory for certain classes of service, it did not meet all demands, resulting in the advent of the induction feeder regulator, such as shown in fig. 1. This regulator was readily adaptable to hand, motor or automatic operation.

In recent years the step-by-step type regulator has been modified and adapted to automatic operation, so to-day there are on the market two types of regulators for automatic operation, namely, the step-by-step type and the induction type. It is the writer's belief, however, that the latter type possesses certain advantages over the former type, which justifies its use for practically every condition of service. These advantages may be summarized as follows:

Fig. 2.

First, the absence of contacts, which require frequent repairing and replacing.

Second, the infinite number of voltage steps, permitting very close and uniform regulation throughout the range.

Third, no definite points on which the regulator must stop when raising or lowering the voltage.

Fourth, accessibility in case repairs are necessary.

Fifth, simplicity of construction.

There have been certain objections raised to the induction type of feeder regulator, such as noisy operation, high magnetizing current and

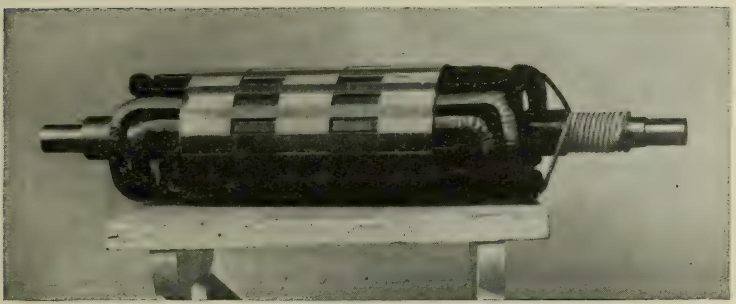


Fig. 3.

slow speed of operation. These, however, have all been overcome in the induction regulator of to-day, such as shown in figs. 1, 2 and 3. Fig. 2 shows the regulator out of the case, and fig. 3 the moving element. Noisy operation of the single-phase regulator has been eliminated by a design in which the air gap between the moving and stationary elements can be kept uniform, thereby resulting in a balanced magnetic circuit. This has also been further assisted by providing a rigid moving element with a heavy shaft and decreased distance between bearings. Therefore, the noisy induction feeder regulator of to-day is either defective or incorrectly designed.

The construction of the induction feeder regulator is very similar to that of an induction motor, as will be seen from fig. 4, which shows the winding of the single-phase regulator. The lines of force shown in fig. 4 give the magnetic flux distribution of the regulator in the neutral

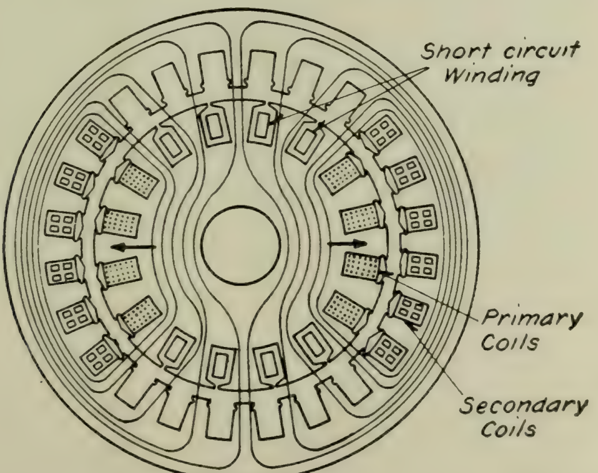


Fig. 4.

position with a uniform air gap, and bring out the function of the short circuited coils on the moving element. To change the voltage, that is, to boost or buck the line voltage, the moving element would be revolved until it reached the position 90 degrees from that shown in the figure, which would be the position of maximum buck or boost.

The hand-operated induction regulator is the same as the motor-operated regulator, as shown in fig. 1, except that the motor, limit

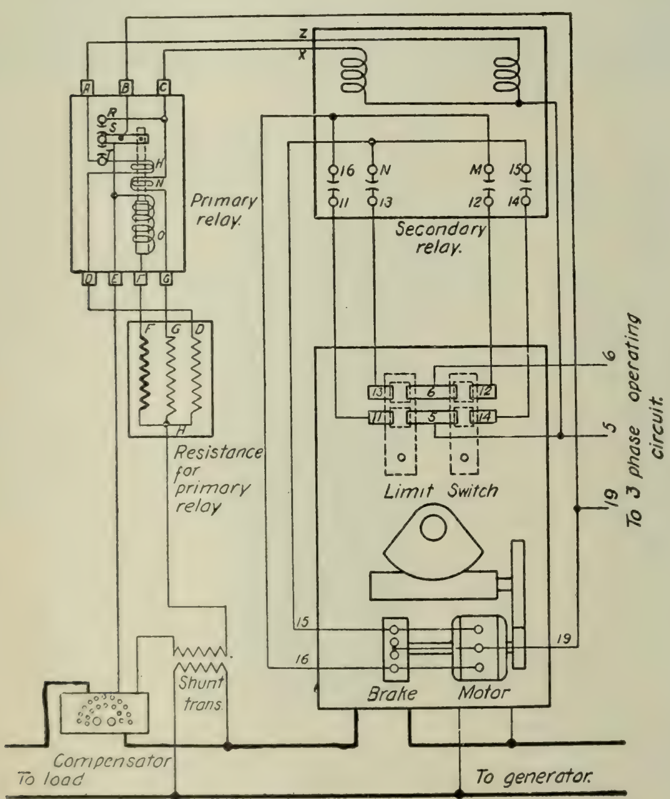


Fig. 5.

switch and brake are omitted and only the hand wheel provided, which controls the moving element through a segment and worm mounted on the top of the regulator. The motor-operated regulator includes a limit switch, break and motor. The function of the limit switch is to open the motor circuit and stop the regulator when it has reached the position of maximum boost or buck. The brake magnet is connected in parallel

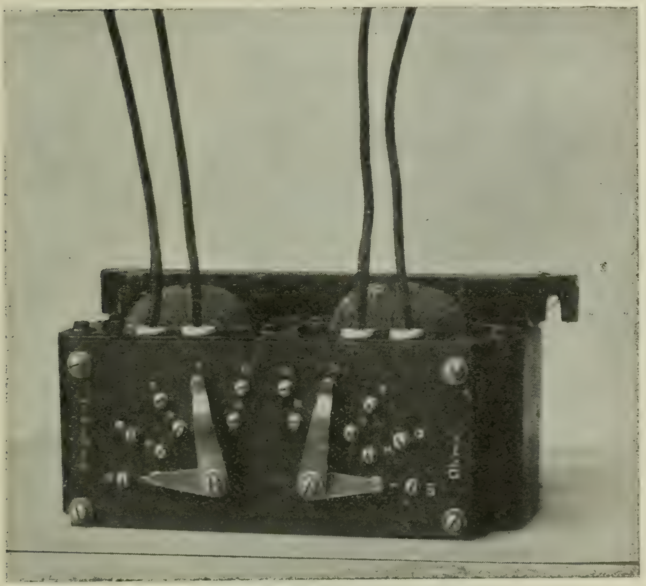


Fig. 6.

with the motor circuit, and when the current is applied to the motor the brake is released, allowing the motor to revolve freely. When the motor circuit is opened, the brake is applied, instantaneously stopping the motor and preventing the regulator from over-travelling. The automatic induction feeder regulator consists of the motor-operated regulator with primary relay, secondary relay, or contact making voltmeter, compensator, series transformer and potential transformer, which are connected as shown in fig. 5. From this it will be seen that the primary relay is in series with the secondary of the line drop compensator and obtains its power from the voltage transformer connected across the feeder to be regulated. The function of the compensator, fig. 6, is to introduce in this circuit percentages of ohmic and reactive drop in proportion to those of the feeder circuit, thereby giving a circuit of approximately the same relative characteristics as those of the feeder. The primary relay, as shown in fig. 7, consists of a solenoid magnet, which controls the armature supporting the contact. This armature is also influenced by two auxiliary coils, which increase the pressure of the contacts at the moment of contact and thereby prevent the chattering usually experienced in contact-making voltmeters. This relay controls the secondary relay, fig. 8, which in turn controls the motor circuit. This secondary relay is of the positive switch type, and so designed that contact cannot be made on one side at the same time as on the other, thus preventing any chance of rebound, as was sometimes experienced in the pendulum type of relays.

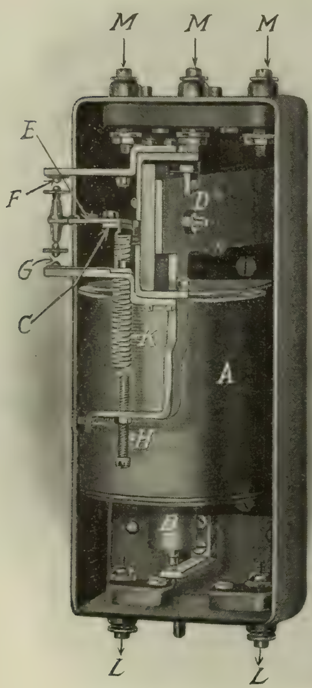


Fig. 7.

As a rule, the regulator capacity is approximately 10 per cent. of that of the feeder, which represents a regulator for 10 per cent. boost or buck and, therefore, the efficiency of the regulator does not represent the efficiency of the feeder. For instance, with such a regulator the effect on the feeder efficiency would only be about one-half of one per cent. The following figures show the influence of the regulator on the power factor of the circuit, the regulator having an efficiency of 94.7 per cent., a power factor of 82 per cent., and being in the position of maximum boost:

Power factor of circuit, not including regulator	100	95	90	85	80	75	70
Power factor of circuit, including regulator	98.8	93.5	88	82.7	77.8	72.8	68.3
Decrease in power factor due to regulator	.2	1.5	2.0	2.3	2.2	2.2	1.7

Therefore, it may be seen that the power factor of the feeder is only slightly influenced.

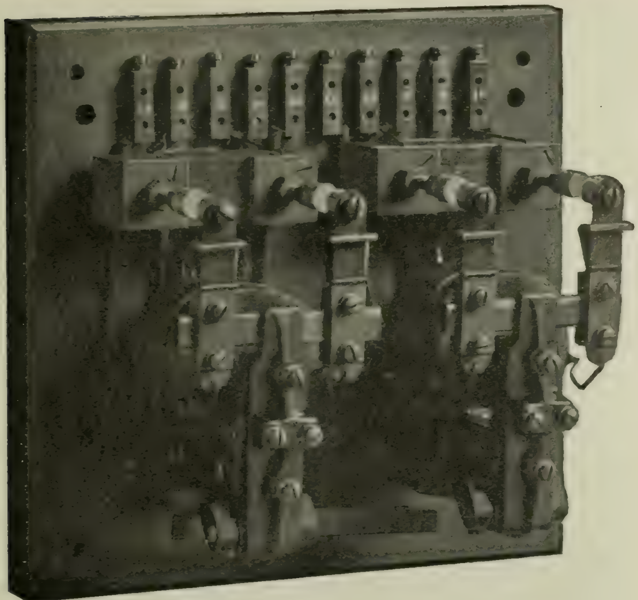


Fig. 8.

It should be remembered in considering this question that the magnetizing current taken by the regulator is not passed along the line and in no way affects the line. The only part of the system affected are the station generators, and as the value of this current is fixed, they may be adjusted to take care of it.

There has been considerable hesitation on the part of various central stations as to the most efficient speed of the regulator; that is, the time required for the regulator to travel from maximum boost to maximum buck. Considering that a regulator does not eliminate the causes of voltage fluctuations on the feeder, but serves only to bring the voltage back to normal, it would seem that the higher the speed the more satisfactory the results obtained. This is only true in practice beyond certain limits. The ordinary time required for the complete range is from five to thirty seconds, hence it is practically impossible to get a regulator that will take care of the very rapid fluctuations in voltage, which occur within a fraction of a second. For instance, take a change in voltage which occurs within one-half of a second, a regulator with a speed of three seconds will no more take care of such a variation than one with a speed of thirty seconds, and when considering the wear and tear on all moving parts of the regulator and its auxiliaries, it is found that the most economical and satisfactory speed is approximately twenty seconds from maximum boost to maximum buck. Fig. 9 shows a voltage

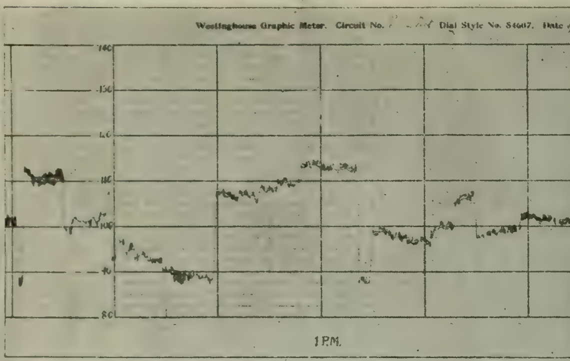


CHART TAKEN ON THE UNREGULATED SIDE OF A FLUCTUATING CIRCUIT. WESTINGHOUSE GRAPHIC RECORDING VOLTMETER USED: SCALE 2½ VOLTS PER DIVISION; RATE OF FEED, EIGHT INCHES PER HOUR

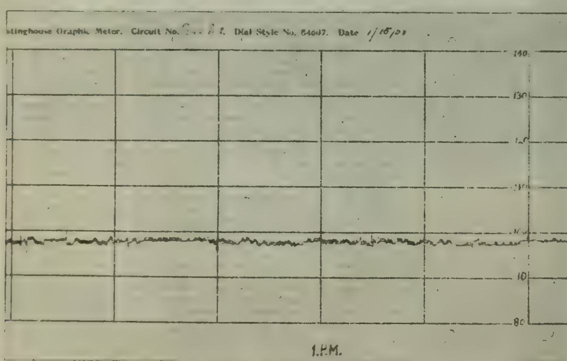


CHART TAKEN SIMULTANEOUSLY ON THE SAME CIRCUIT AFTER PASSING THROUGH THE REGULATOR VOLTAGE REGULATING RELAY SET FOR 98 VOLTS NORMAL PLUS OR MINUS ONE-HALF VOLT, SENSIBILITY SETTING

Fig. 9.

chart of a feeder before and after regulation with a twenty-second regulator. As usually there are few fluctuations in the feeder voltage that are of such a magnitude as to require the regulator to move continuously from one maximum position to another, it is obvious that the average variation will be properly taken care of in a very short period of time. In further reference to the speed of a regulator, it is also necessary to take into consideration the limits within which it is desired to maintain the feeder voltage. The primary relay shown herein may be adjusted to bring the voltage back within three-quarters of a volt of a predeter mined normal. It is, however, sometimes desirable, depending upon the speed of the regulator, as well as the characteristics of the feeder, to adjust this relay so that the voltage will be brought back to within one or one and one-quarter volts of the normal voltage, this being due to

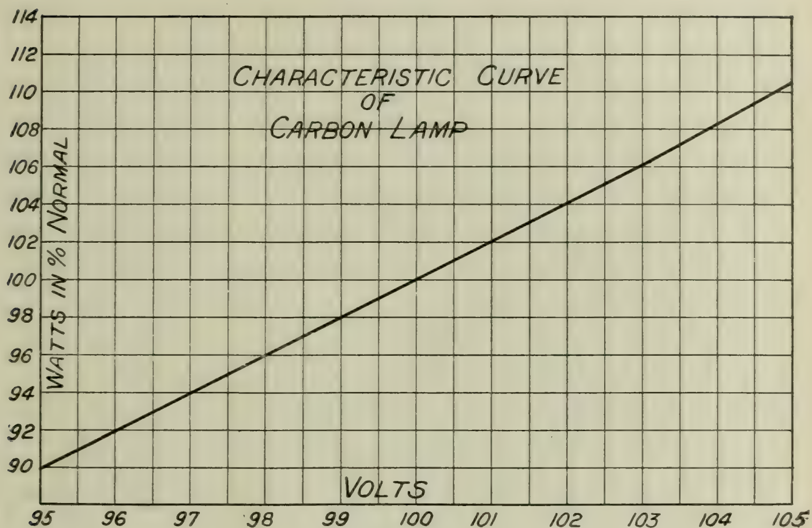


Fig. 10.

the fact that, with a feeder which has frequent and rapid fluctuations of approximately three-quarters to one per cent., the regulator would be continually in operation and the wear and tear proportionately increased. All these facts must be considered in connection with the automatic feeder regulators regardless of the type. With a regulator having a speed of twenty seconds and using the adjustment on the primary and secondary relays as shown herein, there are practically no conditions on a feeder within the capacity of a regulator that cannot be taken care of satisfactorily.

The most desirable arrangement for the control of the voltage of a station is to have a generator voltage regulator on the generator controlling the terminal voltage, and a feeder regulator for each feeder. This arrangement has been appreciated by many of the larger distribution systems which are to-day using feeder regulators on all feeders, in addition to their generator voltage regulators.

For the medium size central station it might appear that the result obtained by the use of regulators would not justify the initial cost. However, in analyzing the variation in the life, the watts consumed and the candle power of incandescent lamps, with the variations in voltage as seen in figs. 10, 11 and 12, it is obvious that for a small change in voltage there is a large change in the life of the lamp as well as the watts supplied and the resultant candle power. When further considering satisfactory service and satisfied customers, which is indirectly a valuable asset that can be expressed in money value, the advantages of a regulator are such that no modern central station having more than one feeder can economically do without the feeder regulator.

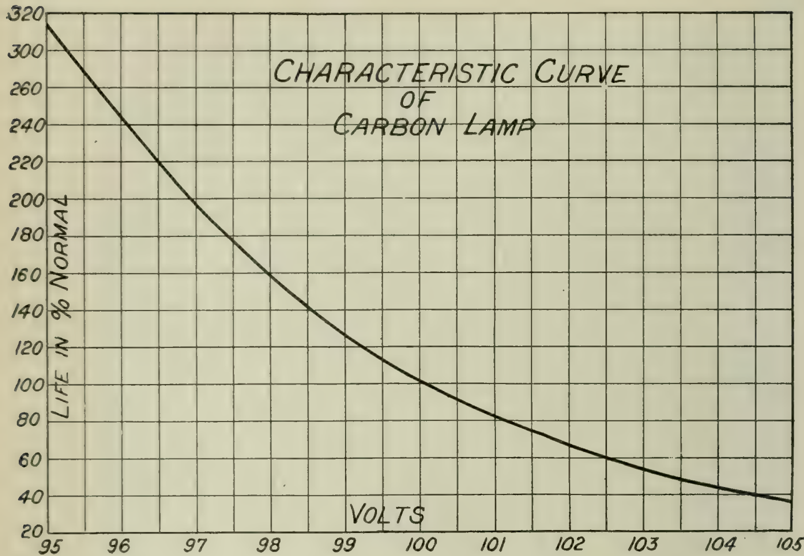


Fig. 11.

Taking for an example, a 220 kva. feeder with an incandescent lamp and heating apparatus load equivalent to full load for six hours per day and assuming the net price of a 22 kva., 60 cycle regulator, to provide 10 per cent. regulation, as $900.00, it will be seen that the regu

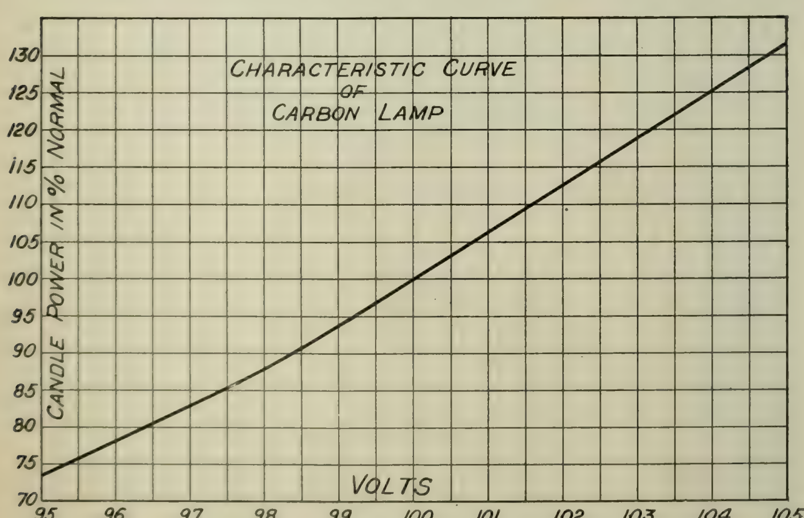


Fig. 12.

lator will approximately pay for itself within the course of two years. This is based upon the following assumption. The cost of power delivered is 1 cent per k.w. hour, and it is resold at 10 cents per k.w. hour, the cost of a 16 c.p., 50 watt lemp is 16 cents, its life is 800 hours, and the cost of handling lamps is 1½ cents each, and the average voltage of the feeder is 1 per cent. below normal.

Considering purely an incandescent lamp load it will be seen from the curves that for a one per cent. decrease in voltage, the watts delivered decrease two per cent., while the life of the carbon lamps increases 25 per cent., which would give a life for the lamps of 1,000 hours instead of 800. Operating the lamps at six hours per day would mean 2,190 hours per year, multiplied by 220 kva. would give 481,800 kva. hours per year. This multiplied by two per cent. decrease, would give 9,636 kva. hours loss per year, with a one per cent. decrease in voltage. This figured at 9 cents per k.w. hour, which is the difference between the selling price and the cost of the power, and represents a loss to the central station, would equal $867.24, amount lost by the one per cent. decrease in voltage due to the decrease in the supply of power. To partially offset this we would have the life of the lamps increased to 1,000 hours, which would decrease the number of lamps required during the year from 12,060, representing the number with an assumed life of 800 hours to 9,640, representing the number of 1,000 hours life, the saving being 2,420 lamps. This number, figured at 16 cents each, equals $387.20. Figuring the cost of handling the lamps at 1½ cents per lamp, equals $36.30 saved in handling. Therefore, the total amount saved in lamps would be $423.50. Deducting this from the amount lost by the decrease in the amount of power saved, gives a net saving of $443.74 by the use of a regulator. It must be remembered that with this loss resulting from the lower voltage goes a decrease in the candle power of the lamp of approximately 6 per cent., which would result in poor light and dissatisfied customers.

In the above example the question of line losses, etc., has been omitted, and if these were considered the length of time required for the regulator to pay for itself would be somewhat increased. In going over this illustration and referring to the curves, it may be asked by some why it would not pay to run at a higher voltage continuously on account of the increased power supplied, which would more than offset the lamp renewals. From actual figures taken from the curve based on a one per cent. increase in voltage, it would at first appear that a saving could be realized on the same capacity feeder in case the voltage were run at 101 per cent. instead of 100 per cent. In considering this, however, it must be remembered that the most efficient service is obtained from electrical apparatus operating under the conditions for which it is designed. The result will also be influenced by the use of tungsten lamps, also the practice followed in connection with renewals of carbon lamps, and with a diversified load consisting of lamps, heating apparatus, motors, etc., the results will differ somewhat from those given in the ex-

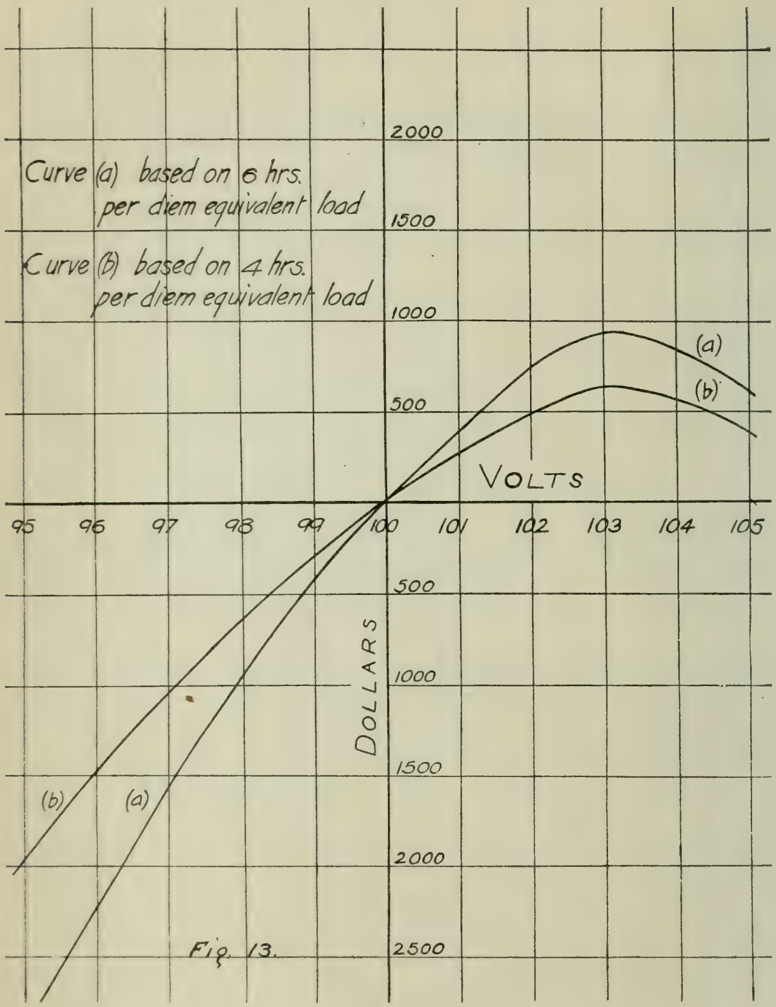


Fig. 13.

ample, inasmuch as the line loss as well as the efficiencies of the operating apparatus is influenced. Fig. 13 shows the curve of a 220 kva. feeder, from which the amount lost and saved can be determined for various voltages above and below the normal of 100 per cent. This curve brings out an apparent saving at the higher voltage.

As the voltage is lower than the normal under average operating conditions, the regulator is boosting the greater portion of the time. It is, therefore, readily seen that, regardless of the value of the normal voltage, a feeder regulator is an economical investment to eliminate fluctuations in the feeder voltage.

DISCUSSION.

Mr. Black: Mr. Chairman, the paper which Mr. Allen has presented is certainly a very interesting one, particularly as a great many companies in Canada are getting their current from transmission lines. In the early days, when the circuits were small and each power house had its own generators where it could have full control of the current, it was possible by manipulating the field current and raising the bus bar voltage at the time of heavy loads to give fair regulation, but now, when we are purchasing current from supply companies who are supplying a number of different cities, or have a number of different lines radiating from their bus bars, we have to take the voltage which the power company gives us, and consequently we have no control in our various sub-stations other than by regulators of some type, either of the transformer type or the automatic type which Mr. Allen has so ably described. In considering the purchase of regulators one is tempted, on account of the price of automatic regulators, to take the transformer type with steps. The great disadvantage in this is you have to depend upon a hand regulator, and you cannot always depend on your operators being careful enough at all times during the twenty-four hours to regulate the current close enough. At times when there is a light load there is quite a perceptible flicker when the contact switch is changed from one point to the other. The regulator which Mr. Allen has described does away with this flicker and does away with the necessity of depending on the operators. The regulator is worked in conjunction with the line drop compensator so that you can set your regulator to compensate for the drop in the line in such a way that you can keep the voltage practically constant at a point two or three miles distant from your substation, which is a very decided advantage. It would seem to me that the manufacturers ought to do something towards cutting the price of these regulators down. They are out of proportion with the cost of other apparatus, if the prices which they quote me are any criterion. It seem too bad that it should be so, because the service to the public could be very much improved by the use of these regulators.

Mr. Scott: The regulation on a circuit tends to give uniform voltage, and therefore affects the quality of the service. It bears directly upon the same line of argument which I advanced this morning, namely, the importance of the quality of service. If a central station has a few minutes interruption, or half an hour's interruption at one time during a year, the customer will not say that for eleven months or for three hundred and sixty-four days and twenty-three and a half hours he has had a continuous service, but the one thing he will remember is that five minutes or half an hour when the service was lacking. It will not be so much the continuity of service, even if it be perfect, that will impress the average citizen, as the flickering lights, or that their low candle power voltage is poor. Even occasional poor light gives the service its reputation in the minds of those who use it, and consequently as a means to good service any device which can straighten out the very irregular

curves shown in Mr. Allen's figure No. 9 in the upper curve sheet, and give something which is so nearly perfect as that shown on the lower part of the curve, is something which has a very tangible value in rendering excellent service, entirely apart from such commercial savings as Mr. Allen has pointed out in any particular case.

With regard to the cost of the regulator, first of all the regulator itself is a difficult piece of apparatus to make. It is simple in one sense, but the induction regulator is something that involves a good many difficult points. In one sense it is a kind of induction motor, but it is a single phase motor instead of a poly-phase motor. It does not rotate and get the advantage of circulating air and ventilation which a motor does. Certain conditions in the design make it necessary or desirable to make a very long regulator of small diameter. That is, the part that corresponds to the rotating part of the motor is long and of small diameter, and the stationary winding must be in small long grooves. It is relatively difficult to manufacture compared with other apparatus, and it has a very difficult service to perform. All in all, what seems a very simple thing—a regulator controlled by a motor and relay—is really a complicated piece of apparatus, of many parts, which must be made for durability and high reliability in continuous operation in order to serve its purpose. A word may be said with regard to the cost of regulators. Mr. Allen refers to a $900 regulator for a 220 K.W. feeder. This is about $4.00 per K.W., or, if we take 20 per cent. to cover the annual interest, depreciation and repairs, which is probably a high figure, we get an annual charge of 80 cents per K.W. per year. This is considerably less than 1 per cent. of the income estimated by Mr. Allen. If the difference between a variable service and a good service can be secured at a cost of less than 1 per cent. of the income, certainly it is well worth while to supply good service. In other ways the regulator may lead to a saving. Instead of installing large feeders in order to minimize the drop in voltage, it will often be practicable to install feeders of smaller cross-section at less cost which will ordinarily give a greater drop in voltage. This drop, however, can be properly compensated for by the regulator. Hence the reduced cost of copper in feeders may result in a saving in investment. In other cases where the feeders are bcoming overloaded, the desired regulation can be secured by means of a regulator instead of installing additional feeders. The whole regulator problem is a large one and one that cannot be given in abstract terms, but each individual case must be considered in order to get all the benefit and advantages. It certainly is one of the factors making for good service. For twenty years regulators have been wanted. There was a call for automatic regulators fifteen or twenty years ago, possibly not as strenuous as it is now, but there was a demand then, and there has been a disposition on the part of the manufacturer to produce an efficient and cheap regulator, but the apparatus has not been forthcoming until the last few years, when regulators have been produced in considerable numbers, and have reached the development they now have. It has

required a great expenditure of brain power and experimental development to secure that which we now have.

Mr. McDunnough: I would like to ask the author of this paper if they have entirely succeeded in eliminating the noise. We had one about two years ago and there seemed to be a sort of dead centre, and when the regulator would get on that point it would make so much noise that we had to throw it out.

Mr. Pratt: There is one point which I do not think the writer emphasized sufficiently, and that is the importance of feeder regulation on lighting circuits, owing to the rapidly increasing use of small single phase motors, which are made in great variety, and are adapted to almost every class of business, and for domestic use, there already being a very considerable demand in dwellings for utility motors, fan motors and vacuum cleaners operated by small single phase motors. There is nothing which will cause more dissatisfaction among these customers than a drop in voltage below the point of operating the motor satisfactorily and, as you will agree, the self-starting single phase motor will not operate satisfactorily over a very wide range of voltage. It is this point which I think should be taken into consideration when considering the advisability of using feeder regulators.

The President: There is no doubt, gentlemen, as to the advantages of close regulation. All that has been said in the paper and by the speakers in that respect is correct. The difficulty with the small station agent is that if they were to use everything that could be used to improve their conditions and which can be shown would pay for themselves, inasmuch as the annual cost is less than what is saved in other directions, the company would get in a condition where it might not be able to finance itself. It means a large outlay, and though in the final outcome it might be a saving, that is always a difficulty. The question of noise is important because we are coming now to having sub-stations in residential districts, and sometimes the noise of a great many regulators in one building would be considerable and would be objected to.

Mr. Allen: The trouble with noisy operation is only experienced in single-phase regulators. In polyphase regulators there is very little tendency to vibration, due to the magnetic pull across the air gap being the result of two or more single phase fields, thus giving it a constant value at all times. In the single phase regulator this noise is usually caused by an unequal air gap and weak mechanical construction.

When we first started out to manufacture single phase regulators considerable trouble was experienced with noisy operation, some of the regulators being heard above everything else in the station. We overcame this trouble by increasing the size of the shaft and supporting the entire regulator from the cover, which practically ensured a uniform air gap. In addition to this, however, we placed a felt gasket on the top flange of the case, and on this the cover was placed, thus deadening any slight vibration which might exist. By this precaution we have

been able to guarantee practically noiseless operation as far as the regulator proper is concerned. Of course, there will be a certain amount of noise due to the operation of the gear and the brake, but this is practically negligible.

There was a question brought up by the Chairman in regard to the small stations. It seems to me that economy is going to be more important each year. In other words, where we were economizing ten years ago to save 100 watts, we are economizing to-day to save one watt, and probably within the next five years we will be striving equally as hard to save a fraction of a watt. While you may not have felt this demand for greater economy here in Canada, it is quite apparent in the States on account of the general movement pertaining to the conservation of the natural resources.

It is just as essential that the small station run on an economical basis as the large station, and perhaps more so, because in the large station your relative expenses are less, due to the fact that one attendant can take care of a 10,000 k.w. unit as easily as a 100 k.w. The large station is also in a position, on account of its large demand, to buy at a lower price than the smaller station. In the smaller station you are probably confronted with the problem of insufficient capital to fight competition that may come into the city, which is more likely to be agitated in a small town than in a large one, and you must give the best service in order to keep the public in such a frame of mind that they will not support the competing plant. Also, your cost and resale price of power is larger in a small station, and as your regulator results in a saving on the basis of the resale price, the percentage of economy in the smaller station is greater than in a larger one.

The President: We are indebted to Mr. Allen for coming here to give us this contribution. It is a highly important subject and one we must all deal with sooner or later.

The next paper is one by Mr. Roderick J. Parke, on ''Some Recent Developments in Electric Heating and Cooking Devices.''

Mr. Parke: Mr. Chairman and gentlemen, when I had the honor of being requested to give a paper before the Convention the opportunity for investigation was more or less limited, on account of not having all the apparatus at hand which I could have wished. It is a rather difficult matter to give facts and figures and tests without to a certain extent indicating the type, and through that the name of the manufacturer, and I therefore endeavored to refrain from that as much as possible.

SOME RECENT DEVELOPMENTS IN ELECTRIC HEATING AND COOKING DEVICES

By Roderick J. Parke

It is a rather curious fact that the science of electric heating and art of cooking by electricity, a combination which will in the long run prove one of the most profitable sources of revenue for the central station, has been the most retarded in development. This is due to two primary causes; firstly, the relatively high price at which current has been sold until recently in the
high price at which current has been sold until recently in the
larger installations, not to mention the comparatively high prices still prevailing in most of the smaller stations; and, secondly, the failure of inventors and manufacturers to improve upon the original electrical heating and cooking inventions in the same ratio as improvements have been forthcoming in the field of electric lighting and power devices. It is a series of long steps from the pine torch to the tungsten lamp by way of the tallow dip, the wax candle, the kerosene oil lamp, and the gas jet, and a series of equally long, or longer, steps from the aboriginal camp-fire to the electric heater, with the mile-posts marked by the primeval fire-place with its roasting spit, the stone oven, the wood stove, the coal range and gas stove. It seems to be a law of human evolution that the rate of progress is somewhat inversely proportional to the square of the time. It is of course difficult to give a concrete illustration of the working of the law, but the idea can be approximated by pointing out that where it has taken the steam engine about 100 years to reach its present stage of development it has taken electricity but little over ten years to progress in the same proportion. The central station manager is now at the threshold of a development of the application of electricity to the heating and cooking services of man which is epoch-marking. The first electric heaters on a commercial basis appeared less than twenty years ago and since then their development has been rapid, until now we have appliances devoted to almost every conceivable purpose of the household, electricity outrivalling all of its competitors. It is obvious, therefore, that the time was never more opportune for the central station manager to look about and avail himself of the possibilities which a few years ago were almost unthought of in the way of increasing the extent and utility of his public service system, and incidentally its value as an investment.

Among the earliest devices for heating by electricity was the hot wire coil or radiator, an evolution from the old-fashioned rheostat, the radiator being practically nothing else than a rheostat applied to a purpose for which it was originally not intended. Following the hot-wire radiator came the disc-heater, and as the development of this type of apparatus progressed, further varieties of heaters were developed. The disc-heater in its simplest form is to-day, as it was at the outset, one of the most generally useful appliances brought into the household. The greatest obstacle to its progress had been the relatively high prices which prevailed for current, but since current became available

at relatively low prices, the perfection of the various forms of electric heating devices advanced rapidly.

The number of types of electric heating appliances now available, and the variety of their applications is remarkable. In addition to the simple disc stove are electric flat irons, coffee percolators, chafing dishes, toasters, tea kettles, water heaters, food warmers, plate warmers, teapots, and other dining room fixtures, also conveniences for other parts of the household, such as curling tong heaters, thermo-pads, hair dryers, massage vibrators, foot warmers, small radiators and immersion coils. In the factory and workshop are to be found every type of smoothing and polishing iron which has been popular in the more simple forms, also glue pots, sealing wax pots, solder pots, pitch kettles, soldering irons, embossing press heaters, matrix driers, laundry rolls, puff irons, water heaters, and even electrically heated steam boilers. In the hospital and laboratory are to be found wet and dry sterilizers, flask heaters, milk testing sets, bacteria incubators, and similar appliances in great variety. Almost every up-to-date dental laboratory is equipped with an electrical sterilizer and a muffle for the manipulation of porcelain for teeth, etc.

Not included in the foregoing, because special mention is now to be made of it, is the electric oven. The development of this apparatus has unfortunately not kept pace with that of other heating appliances, because the high cost of heating ovens by electricity as compared with wood, coal and gas has militated greatly against its wider adoption, but now that central station managers are daily appreciating more and more the profit to be gained from utilizing their plants for the furnishing of day-loads, the electric oven is about to come into its own, and that it will amply repay the attention given to it can be easily demonstrated.

The efficiency of electrical heating apparatus has increased from approximately 40% in the earlier types to as high as 85% in a later type, namely, the immersion coil heater in which nearly all of the heat available from the current is directly transmitted to the water as such heat can only escape through the water, except for a small percentage lost by convection in the metal. The efficiency of the earliest type of electric oven was not even equal to that of the ordinary wood stove, but as designers became better acquainted with the principles involved in the operation of electric ovens, improvements were from time to time made, until there are now on the market several types which possess a relatively high efficiency. The tendency has been to adhere to the more or less portable types, hence the maximum efficiency was difficult to obtain, because increase of efficiency depends not only upon the method of applying the heat but upon conserving the generated heat as well, thus necessitating a substantial increase in the weight and cost of the oven, an objection which manufacturers seemed unwilling to dispose of.

The earliest form of electrical oven consisted of merely a sheet-iron box with hinged door, and a hole cut in the bottom, so that the case could be set upon a portable disc-heater. Naturally, this type of even was grossly inefficient because black iron was used and no attempt was made to prevent the escape of the heat, the radiation loss being so large as to waste more heat than was utilized in the contents of the oven. The next step was the placing of an element in the oven itself making the whole a self-contained unit. This type

was but slightly more efficient than the original type and a further improvement was made in constructing the oven with an inner and outer lining with an air space between, thus reducing the radiation losses and raising the efficiency. This was still unsatisfactory, however, because the efficiency was yet too low. The next improvement consisted of filling the space between the inner and outer cases with a thermal non-conductor which resulted in another increase in efficiency. This design in general represents the present standard type of electric oven, but considerable variety is to be found in these more improved types. The latest types are designed somewhat upon the lines of the gas range and comprise an oven heated with one or more interior elements, usually two, one placed in the bottom and one in the top of the oven and also upon the top of the oven one or more hot plates or hot wire radiators so arranged that one or more degrees of heat can be had by switch control.

The development of the gas oven from the ordinary gas burner has been practically but a single step, because the relative economy is not materially changed when a number of gas burners are combined on one stove to perform a variety of culinary operations. The facility with which, and low cost at which, gas can be stored solves the greatest difficulty which the central station has to contend with, namely, taking care of the peak load, hence the necessity of keeping the maximum demand on the central station down to the lowest possible minimum has tended to discourage the use of the complete electric range. Up to the present the development of the art of cooking by electricity has resulted from the use of a large variety of individual appliances, but if it is to become a successful competitor of the coal range and the gas stove, its development must be along lines similar to those of the gas range, namely, maximum variety of application in minimum space at minimum initial and operating cost with minimum demand upon the capacity of the central station. Any device which will tend to reduce the load factor and yet combine the maximum number of operations within the smallest space and at relatively low initial and operating cost would therefore be a step in the right direction.

That this question may be considered intelligently it is necessary to make a brief study of the cooking processes in use in the average household and to determine the most effective combination of these processes which can be had at minimum cost.

The art of cooking falls naturally into three separate divisions, namely:

(1) BOILING. This includes the heating and boiling of fluids, such as heating water, making tea, coffee, soup and other liquid food preparations, also the boiling of solid food, such as eggs, fish, meats, pudding, etc., in which operations the temperature of the food is never raised above 212° F.

(2) FRYING. This includes also broiling and grilling. In these processes heat at a temperature above 212° F. and generally under 400° F. is applied to the outer surface of the food, usually on the under side. The process is done over an open source of heat, such as a bed of coals, a gas flame, or an electric disc heater.

(3) BAKING AND ROASTING. As these processes require that the heat shall be uniformly distributed over the surface and throughout the mass of the food, an oven in some form or other is indispensable. The temperature to which the food is subjected will range from 150° F. for baking puddings, to 400° F. as a maximum for roasting joints of beef, etc. The principle is prac-

tically the same for baking and roasting except that in roasting the outer surfaces are subjected to heat above 212° F. in order that the tissues may be seared or partly carbonized or, in popular terms, roasted.

With a very few exceptions, all the processes enumerated above can be done in an appropriately designed oven. The exceptions are the making of liquid food preparations, which can now be more efficiently done by means of the open or disc type heaters than on the coal or gas stove. Hence, given an oven capable of performing all the other processes, the entire field of electric cooking can be covered by two pieces of apparatus, namely, the open disc heater and the oven, and even these two can be advantageously combined in a single device.

In fact the latest types of electric ranges are designed for universal application in single units.

The earlier and simpler types of electric heater were used almost exclusively for warming liquids and boiling processes until a higher efficiency was attained in the disc-stove, when frying and broiling by electricity became practicable, and, finally, with the advent of the electric oven, baking and roasting by electricity became practicable, and will constantly become more popular as the cost of these operations is gradually reduced in proportion to the increase of efficiency of the oven.

Apropos of efficiency and the comparative cost of baking and roasting by gas and electricity respectively, a report made in September, 1905, by the Heating Committee of the Association of Edison Illuminating Companies pointed out that one pound of average anthracite coal has a thermal value of 12,000 B.T.U. and will produce 5 cu. ft. of gas having a thermal value of 3,000 B.T.U., with an efficiency in heat conversion of 25%, or, in other words, 75% of the thermal value of the coal is lost in converting it into gas. With fairly efficient generating apparatus one pound of coal will produce 0.25 kilowatt hours, equivalent to 853 B.T.U., the efficiency in heat conversion being equal in this case to 7.1%, and dividing this by 25% the efficiency of gas heat conversion, we get 28.4%; in other words, an electric unit generated by coal will cost nearly four times as much as an equivalent gas unit generated from the same kind of coal. But as in some cities gas is actually selling at $1.00 per 1,000 cu. ft. the cost of 1 B.T.U. is .0001674c., and with electricity at 10c. per K.W.H the cost of 1 B.T.U. is .00293c. The efficiency of electric heating apparatus being at least four times that of gas, owing to the more direct application of the heat and smaller losses by no heat being carried off in combustion draft, a gas unit requires four times as many B.T.U. to do the same work as an electric utensil. If then the rate for electricity is reduced to one-quarter of 10c. per K.W.H., or 2.5c., we find that the cost for heating by electricity is practically the same as that of gas at $1.00 per 1,000 cu. ft. For convenient reference the following table is given, showing the prices at which electricity must be sold to compete with gas at prices ranging from 50c. to $2.00 per 1,000 cu. ft.

Table No. 1

Gas @ 50c. per 1000 Cu.ft.	=	Electricity @		1.25c.	per K.W.H.
" 60c.	"	"	"	1.50c.	"
" 70c.	"	"	"	1.75c.	"
" 80c.	"	"	"	2c.	"
" 90c.	"	"	"	2.25c.	"
" $1.00	"	"	"	2.50c.	"
" 1.10	"	"	"	2.75c.	"
" 1.20	"	"	"	3c.	"
" 1.30	"	"	"	3.25c.	"
" 1.40	"	"	"	3.50c.	"
" 1.50	"	"	"	3.75c.	"
" 2.00	"	"	"	4c.	"

It is not the purpose at present to discuss the question of whether the central stations are justified in quoting as low a rate as 2.5c. per K.W.H., further than to remark that any revenue which can be obtained from generating capacity which would otherwise be idle during the day is nearly 100% profit, and the question of making these low rates is well worthy of the favorable consideration now being given to that subject.

It is necessary to disgress here briefly to consider another form of cooking, popularly termed ''fireless cooking,'' which is meeting with much favor and, in consequence, has a comparatively widespread application. That there is a decided economy in the use of the ''Fireless Cooker'' as compared with the coal range and the gas range is obvious when it is borne in mind that the principle involved is merely the saturation of the food with the necessary number of heat units and the placing of the food in a receptacle which prevents the escape of heat, the retained heat being sufficient to complete the process of cooking. In all cooking processes a certain amount of work must be performed with a given article, and it follows that a low maximum of energy must be applied for a long time, or conversely a high maximum may be applied for a short time. For instance, with a maximum load of 100 Watts a roast of beef weighing 2½ lbs. requires 90 minutes for roasting in the ''Fireless Cooker'' which in an ordinary oven can be done in thirty minutes. There are two modifications of the ''Fireless Cooker'' method, one in which the food is placed in a metal pail and brought to desired maximum temperature over a fire or gas burner, the receptacle covered and the whole placed in the heat retainer. The other modification is an improvement on the one just referred to, inasmuch that the heat units are stored in a soapstone or iron disc heated in the orthodox manner and then put into the heat retainer with the kettle of food. This enables baking and roasting processes to be done, whereas by the first method only stewing and boiling processes can be performed satisfactorily because of the lower temperature available.

The simple ''Fireless Cooker'' has several objections, namely:

The length of time required to cook food is from three to five times that required by ordinary stove process.

A fire or stove must be available in any event to heat the food before placing it in the heat retainer, whether the heated disc be used or not. Meat intended to be roasted in the ''Fireless Cooker'' is actually steamed or baked as it is very difficult to maintain roasting temperature unless the losses are compensated by maintaining a supply of heat from an outside source.

The application of the ''Fireless Cooker'' principle has suggested to several inventors a possible gain in efficiency of the electric oven by conserving the heat and this principle has been adopted in several forms of electric ''fireless'' cookers recently placed upon the market. The Hartford Electric Light Co. of Hartford, Conn., has conducted a series of experiments with electrically heated ''fireless'' cookers which have demonstrated in an unmistakable manner that a great gain in efficiency is available by the use of this method.

Another form of heat economizing apparatus has been placed upon the market in England, consisting of a heavy cast iron bell placed over an open disc heater, though in some types the element is placed within the bell. The principle involved is the maintaining of a twenty-four hour load of about 100 to 150 Watts, resulting in a constant temperature of between 300 and 400 degrees F. in the bell so that the apparatus is always ready for use and the load factor is very low, but owing to the considerable weight of the iron cover, which has to be counterbalanced and mounted on substantial supports, it is both unwieldy and inconvenient. It is a fact, however, that the efficiency of the apparatus is high if the twenty-four hour demand be neglected.

Another combination of electric heater and ''fireless cooker'' principles comprises one or more elements within a heat insulated compartment or oven, the elements being adjustable for two or more heats so that the maximum demand need be applied for the initial operation of roasting and after ten or fifteen minutes reduced to a value sufficient to compensate for the loss by convection, radiation, etc. In this type of apparatus care must be taken to reduce the supply at the right time, otherwise a rapid rise of temperature will take place, with consequent danger of overheating and destroying the food and even damaging the apparatus.

There are two well-known types of electric ovens utilizing this combination, in one type the disc element being used and in the other an element consisting of exposed hot wire coils mounted upon a base made of asbestos and other ingredients and pressed into shape. In the latter type additional benefit is derived from the radiant heat of the element. In both types elements are provided upon the top of the oven similar to the burners on top of the gas stove; in fact, the general design follows the typical design of the gas stove or range. Both of these types are strictly non-automatic, rendering it necessary to use care to prevent over-heating of elements, oven and food. Both types are attractive in appearance, exceedingly useful and convenient and with current at a low cost quite economical, but their widespread use is restricted to those localities in which low rates for current are quoted. Where higher rates prevail the use is restricted to the houses of the well-to-do.

Quite recently an oven combining the three fundamental principles of electric heating, heat retention, and automatic control, has been invented

and patented by two young Canadians, and as the tests which have been made upon the apparatus show results far superior to that of any other device hitherto placed upon the market the device is worthy of special mention in this paper. The device consists of an electrically heated oven possessing a high degree of efficiency as a heat retainer, the supply of heat being automatically regulated by thermostatic control manually adjustable for all ranges of temperature from 100° F. to 400° F.

To avoid the making of invidious comparisons, the names of the manufacturers of the various devices are excluded from this paper.

The oven is provided with removably adjustable shelves containing the elements, the element in each shelf being placed in circuit by pushing the shelf against the back of the oven. The oven is mounted upon a stand which is provided with a shelf carrying open wire heaters which may be used for boiling and frying processes. The whole unit is self-contained and is capable of performing practically every cooking process required for the household. A bi-metallic thermostat is installed in the top of the oven in such a position that it is very sensitive to changes of temperature in the interior of the oven and transmits its movement by means of a rod passing through the case to the adjustable control above, an indicating hand and dial being provided and the whole calibrated to indicate the various degrees of heat in the oven. The automatic control is provided with two switches, one to cut off the main current and the other to set the control so that when the current is once cut off automatically it will remain off, otherwise the control will operate automatically to restore the heating current whenever the temperature falls below a pre-determined value. The control can be set to maintain any desired temperature in the oven.

The author had the privilege of making a series of tests of the oven, the results of which are set forth below. Competitive tests were made of a standard gas oven, one of the latest types of non-automatic electric ovens embodying the fireless cooker principle, and the automatic electric oven. The results are shown in the tabulations below.

Gas cost 70c. per M. cu. ft., and electricity 5c. per K.W.H. Cold food in cold oven. Cooking supervised by a non-professional cook. Readings taken by integrating and indicating wattmeters.

Test No. 1 **BREAD**

Particulars.	Gas Oven.	Non-Automatic Electric Oven.	Automatic Elec. Oven.
Weight in	2 lb. 6½ oz.	2 lb. 5¼ oz.	2 lb. 5½ oz.
Weight out	2 " 4¾ "	2 " 3¼ "	2 " 4¼ "
Loss	1¾ " or 4.54%	2 " or 5.37%	1¼ " or 3.33%
Consumption	21 Cu. ft.	1050 W.H.	370 W.H.
Maximum demand		1760 W.	1200 W.
Cost	1.47c.	5.25c.	1.85c.
Time in oven..................	50 mins.	47 mins.	47 mins.
Dough placed in cold ovens and after test bread was	Inside doughy	Well baked	Well baked

Test No. 2 **WHITEFISH**

Particulars.	Gas Oven.	Non-Automatic Electric Oven.	Automatic Electric Oven.
Weight in	Sample	1 lb. 10 oz.	1 lb. 10 oz.
Weight out		1 " 6 "	1 " 8½ "
Loss	overheated	4 " or 15.4%	1½ " or 5.8%
Consumption	and	1300 W.H.	390 W.H.
Maximum demand		1760 W.	1200 W.
Cost	burned.	6.5c.	1.95c.
Time in oven		41 mins.	37 mins.

Test No. 3 **ROAST BEEF**

Weight in	4 lb.	4 lb.	4 lb.
Weight out, including gravy	3 lb. 12 oz.	3 lb. 13 oz.	3 lb. 14½ oz.
Loss	4 oz. =6.25%	3 oz. =4.7%	1½ oz. =2.35%
Consumption	35 C.F.	1120 W.H.	420 W.H.
Maximum Demand		1760 W.H.	1200 W.
Cost	2.45c.	5.6c.	2.1c.
Time in oven	35 mins.	40 mins.	40 mins.

No water or flour added to gravy.
Three samples uniformly rare but very palatable.

Test No. 4 **POTATOES AND ASPARAGUS**

Weight in Potatoes	1 lb.	1 lb.	1 lb.
" Asparagus	8 oz.	8 oz.	8 oz.
" Water	3 "	3 "	No water
Weight out Potatoes	1 lb. ½ oz.	1 lb. 1¼ oz.	15 oz.
" Asparagus	8 oz.	8 oz.	7¼ oz.
" Water	1 "	1 "	No water
Consumption	20 C.F.	880 W.H.	300 W.H.
Maximum Demand		1760 W.	1200 W.
Cost	1.40c.	4.4c.	1.5c.
Time in oven		34 mins.	33 mins.
Remarks	Potatoes absorbed ½ oz. water	Potatoes absorbed 1½ oz. water	Potatoes and Asparagus cooked in own juice, no water being required owing to retention of steam in oven.

Potatoes and Asparagus cooked at same time in separate pans.

Test No. 5 **CARROTS**

Weight in Carrots	12 oz.	12 oz.	12 oz.
" Water	2 oz.	2 oz.	No Water
Weight out Carrots	10 oz.	10 oz.	10 oz.
" Water.	2 oz.	2 oz.	
Loss	2 oz. =16.6%	2 oz. =16.6%	2 oz. =16.6%
Consumption	20 C.F.	700 W.H.	250 W.H.
Maximum Demand		1760 W.	1200 W.
Cost	1.4c.	3.5c.	1.25c.
Time	34 mins.	34 mins.	33 mins.

REMARKS ON TEST No. 5.

GAS OVEN—2% water evaporated and replaced by 2% soluble matter from carrots.

NON-AUTOMATIC ELECTRIC OVEN—2% water evaporated and replaced by 2% soluble matter from carrots.

AUTOMATIC ELECTRIC OVEN—No water required for carrots in this test. Carrots of superior flavor and appearance on account of no water being used. No butter used, being put in perfectly dry.

Test No. 6 **SPONGE CAKE**

Particulars.	Gas Oven.	Non-Automatic Electric Oven.	Automatic Electric Oven
Weight in	1 lb. 6 oz.	1 lb. 7 oz.	1 lb. 7 oz.
Weight out	1 lb. 3½ oz.	1 lb. 4 oz.	1 lb. 5 oz.
Loss	2½ oz. = 11.4%	3 oz. = 13%	2 oz. = 8.7%
Consumption	22 C.F.	450 W.H.	110 W.H.
Maximum Demand		1760 W.	1200 W.
Cost	1.54c.	2.25c.	0.55c.
Time in Oven	25 min.	25 min.	25 min.
Remarks	Baked satisfactorily	Baked satisfactorily	Baked satisfactorily

Test No. 7 **STRAWBERRY PIE**

Weight in	1 lb. 5¼ oz.	1 lb. 5½ oz.	1 lb. 5½ oz.
Weight out	1 lb. 3 oz.	1 lb. 3½ oz.	1 lb. 3¾ oz.
Loss	2¼ oz. = 10.7%	2 oz. =9.3%	1½ oz. =7%
Consumption	25 C.F.	900 W.H.	330 W.H.
Cost	1.75c.	4.5c.	1.65c.
Time in oven	30 min.	33 min.	25 min.
	Bottom crust pasty, but baking otherwise satisfactory.	Baked satisfactorily.	Result exceptionally satisfactory

As natural gas has relatively one-third the thermal value of commercial fuel gas, and is sold at about one-third the price per thousand cubic feet as compared with commercial gas, the cost of fuel in the above tests would have been practically the same had natural gas been used.

While the foregoing tests were not intended to establish a record for the cooking of a meal as such, the food cooked in each oven was of sufficient quantity and variety, omitting the beverages, to make an adequate meal for six adults. Omitting test No. 2, the aggregate results may therefore be compared in the following:

Table No. 2 **SUMMARY OF HEAT COSTS OF TESTS 1 TO 7**

(Exclusive of Test No. 2)

Article of Food.	Gas Oven 70c. per M. Cu. Ft.	Non-Automatic Electric Oven at 5c. per K.W.H.	Automatic Electric Oven at 5c. per K.W.H.
Bread	1.47c.	5.25c.	1.85c.
Roast Beef	2.45c.	5.6c.	2.1c.
Potatoes and Asparagus	1.4c.	4.4c.	1.5c.
Carrots	1.4c.	3.5c.	1.25c.
Sponge Cake	1.54c.	2.25c.	.55c.
Strawberry Pie	1.75c.	4.5c.	1.65c.
Total Cost of Meal	10.01c.	25.5c.	8.9c.

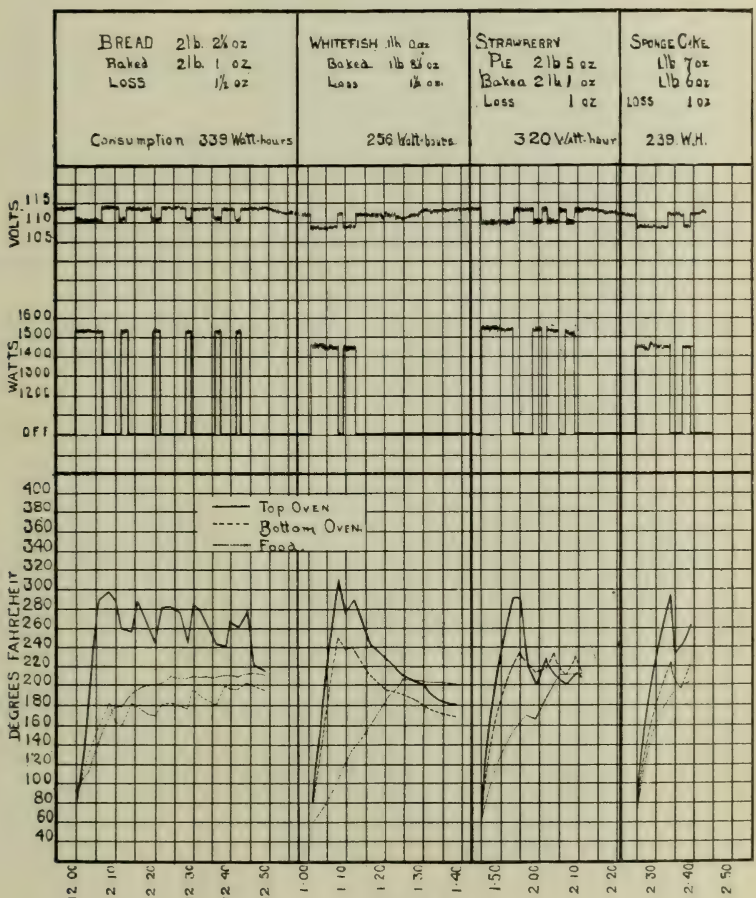
Saving by Automatic Electric Oven over gas at 70c. per M. Cu. Ft. = 13.62%
" " " " " " $1.00 " = 19.46%

Current to cost same as gas at $1.00 per M. Cu. Ft. = 6.25c. per K.W.H.
" " " $0.70 " = 5.8c. "

No special efforts were made to obtain extraordinary results in the foregoing tests, the object in view being merely to ascertain as closely as practicable the actual results under average household practice and conditions. Hence, no highly expert cook was employed to supervise the operations, and the instructions given in the catalogues issued by the makers of the competitive apparatus were closely followed in order that no unfair discrimination would be made. It is only fair to state, however, that an operator thoroughly trained in the use of the non-automatic oven could possibly produce more favorable results; nevertheless, it must be borne in mind that the automatic oven was open to the same disadvantage of an untrained operator during the test.

The author regrets that lack of time prevented him from making a more complete series of tests to determine the characteristics and efficiencies of the automatic electric oven under various conditions of household service, but the foregoing may be taken as representing a very fair average and giving a pretty reliable indication of the commercial advantages and possibilities of the automatic oven, especially in its relation to the central station.

Figure No. 1 shows the voltage, power, temperature and time curves of the automatic electric oven when cooking bread, whitefish, strawberry pie and sponge cake, respectively.



Efficiency Test of Automatic Electric Oven.

One quart of water in an open aluminum pan weighing six ounces was placed in a cold oven with the air at 62° F. and water at 56° F. The door was then closed and the current was turned on, time noted, and consumption of energy measured by means of a wattmeter.

For purposes of calculation the following values were taken:

Weight of 1 Imperial quart of water, 2.5 lbs.
Weight of aluminum lining and other aluminum parts exposed directly to action of heat, including weight of pan = 8.75 lbs.
Weight of metal in the two elements, principally iron = 6 lbs.
Specific heat of water = 1.
" " aluminum = .2143.
" " iron = .115.
" " air at constant volume = .2379.
" " " " pressure = .1688.
Mean specific heat of air in oven allowing for slight expansion and slight increase of pressure assumed to be .2.
Cubic content of oven = 1.44 cubic ft. air.
Weight of air in oven = .10958 lbs. @ 62° F. and allowing for expansion due to increase of temperature assumed to be .1 lbs.
1 thermal unit B.T.U. = 0.293027 W.H.
1 Watt-hour = 3.41266 B.T.U.
Temperature added to water = 156° F.
" " " metal parts = 150° F.
At 100% efficiency water will consume 156 x 2.5 = 390 B.T.U. = 115.29 W.H.

On the basis of the above values, which are based upon reference to recognized authorities, the energy consumed by the water, aluminum lining and pan, and iron elements would be:

Water	390	B.T.U.	=	115.29	W.H.
Al.	281	"	=	82.34	"
Iron	103.5	"	=	30.34	"
Total	774.5	"	=	228.97	"

The energy absorbed by the air need not be taken into consideration because in any event it would not amount to more than .04 B.T.U. or .018 W.H.

The test was started at 11.58 a.m. and the current remained on until 12.10, when it was cut off by the automatic control, remaining off until 12.14.30, when it was automatically restored and again automatically cut off at 12.18. At 12.20 the water had absorbed sufficient heat to bring the temperature up to 212° F. The total time consumed therefore was 22 minutes, during which time the current was actually on for 14.5 minutes, or the equivalent of .2416 hours. The elements consumed 600 watts each, or 1,200 watts for the two, for .2416 hours, equivalent to 290 W.H. This was checked up by readings on both integrating and indicating watt-meters. Temperatures were measured by thermometers placed in the case and in the pan in such a position as to be read without opening the door.

Taking the energy actually required to raise the water to 212° F., namely, 228.97 W.H., and dividing this by the input into the oven actually measured, namely, 290 W.H., and multiplying by 100, the efficiency would be 78.95%, a figure which so far as known to the author has not been equalled by any other device up to the present. An important fact must not be lost sight of, however, in considering the results shown by this test. In heating water or food in the oven the door can be opened for a brief time for inspection of the food, or the food removed, and a very large proportion of the heat will be retained for further culinary operations, thus rendering unneces-

sary the expenditure of the total amount of energy which would otherwise be required to reheat the oven each time a fresh article is to be cooked. This effect materially increases the efficiency of the automatic electric oven as compared with that of any other type in which the heat generated is not retained.

Analysis of the foregoing tests and curves show that:

(1) The addition of the "fireless cooker" principle materially increases the efficiency of the ordinary electric oven.

(2) Automatic thermostatic control of the supply of heating current results in a very considerable gain in over-all efficiency of the electric oven, in addition to the gain derived from the adoption of the "fireless cooker" principle.

(3) Referring to the summary given in Table No. 2, the following efficiencies are apparent:

(a) With current at 5c. per K.W.H. and gas at 70c. per M. Cu. Ft. the saving by the automatic electric oven in cooking a meal for six adults is 13.62%, or practically 14% on the cost of gas.

(b) With current at 5c. per K.W.H. and gas at $1.00 per M. Cu. Ft. the saving by automatic electric oven on the cost of gas is 19.46%, or practically 20%.

(c) With gas at $1.00 per M. Cu. Ft., if current were sold at 6.25c. per K.W.H., the cost of performing a given operation would be the same on both the gas and automatic electric ovens.

(d) With gas at 70c. per M. Cu. Ft., if current were sold at 5.8c. per K.W.H., the cost of performing a given operation would be the same on both the gas and the automatic electric ovens.

(4) The articles used in the foregoing tests were cooked separately, each oven being reheated for each test, which ran the gas and current consumption up to higher values than if the respective ovens had been used in the ordinary manner, namely, cooking several articles at once. If the latter method had been adopted, the actual cost of cooking the meal on each would have been less, because of the saving of gas and current for the reheating of the ovens, but it is doubtful if the relative efficiencies would have been changed materially, as it would require approximately the same time to bring each oven up to the proper temperature for the cooking processes.

(5) The combination of the three fundamental principles of electric heating, fireless cooking, and manually adjustable automatic control, in one piece of apparatus, such as an oven, affords a very flexible unit capable of being adapted to meet almost any system of rates or condition of service, provided that the oven be equipped with interchangeable elements so that the maximum demand of the oven can be limited to any predetermined value. For instance, in localities in which the rates based upon the maximum demand are high, and

the 24-hour-average-load or service rates low, the apparatus can be arranged upon the "fireless cooker" principle to take a low demand and a relatively long time to perform the cooking operations. On the other hand, in localities in which current is sold entirely at a rate per K.W.H., regardless of maximum demand, the same apparatus can be adjusted for more rapid cooking operations, with higher demand but low load factor, thus keeping the customers' bills down to economical limits. Or in localities where restricted service periods are in effect the apparatus can be utilized in such a manner that the cooking operations can be quickly performed with high demand and low load factor, or with low demand and high load factor, as may be required, and the cooking operations completed before the restricted hour period comes on, the fireless cooker principle of the apparatus serving to keep the food hot until such time as it is required.

(6) For rapid cooking operations the load factor of the apparatus is about 30% of that of the non-automatic type of oven, consequently the stand-by or minimum monthly service charge for the automatic oven can be made much smaller than for the non-automatic oven with the same profit to the central station, thus enabling the central stations to quote to their customers very attractive rates for electric cooking service.

(7) During the course of the experiments to determine the relative economy in the three types of oven it was discovered that the automatic oven employing the "fireless cooker" principle can, for a given cubic capacity, cook nearly double the amount of food that the gas or non-automatic ovens can. This is probably due to the local application of the heat from the elements being contained in the adjustable shelves as previously mentioned.

(8) The employment of the electric heating, "fireless cooking" and automatic control principles in an oven means practically perfect cooking, the quality of the output being greatly superior to that of the gas oven in particular.

In conclusion, it should be pointed out that the utilization of electric heating, heat retention, and manually adjustable automatic control principles in an oven or in any one piece of apparatus are capable of a very wide range of application, from use in the pathological laboratory for the incubation of bacteria cultures, to the maternity hospital for use as baby incubators; in the surgical wards and laboratories of hospitals as instrument and dressing sterilizers; in the service rooms of the same hospitals for the keeping warm of food and beverages on each floor or in each ward or even in the private wards of the patients; in apartment houses for what is now popularly termed "kitchenette" services; in domestic science schools for the scientific teaching of cooking by individual demonstrations with absolute control of temperature; and in commercial baking establishments up to any capacity, as the principle is capable of expansion on a very large scale for use in bakeries and biscuit factories with a considerable saving over methods now ordinarily in use.

The President: Mr. Parke has given a very exhaustive treatment of the subject, which almost amounts to a text book on electric heating, showing figures that we have never seen before. If any of the members have any questions to ask Mr. Parke, however, he will be glad to give you any further information.

Mr. Beman: I just wanted to ask if the use of a time switch or clock device for turning off the current was considered.

Mr. Parke: Of course I am not the inventor, but I understand the use of an automatic time switch has been considered and the arrangement may be added and used. There is nothing to prevent it.

The President: I wish to thank Mr. Parke on behalf of the Association for this addition to our proceedings.

The next item of business is the report of the Commercial Committee, of which Mr. Purcell is chairman.

Mr. Purcell: Mr. President and gentlemen, I think as we are behind time it would be in order for this report just to go into the proceedings and not take up time in reading it, as I think some of the gentlemen wish to get away. Mr. Creed was formerly Chairman of this Committee and he got together a good deal of useful information, and all I have done was simply to tabulate it.

REPORT OF THE COMMERCIAL COMMITTEE

As Mr. Eugene Creed resigned in April, Mr. Purcell was appointed Chairman to finish the term.

The Chairman of the Committee, Mr. Creed, called a meeting of this Committee at the Hotel Krausmann, Toronto, on January 20th, and after dinner the meeting was called to order by the Chairman.

Present: Mr. W. H. McIntyre, of the Ottawa Electric Co., Ottawa; Mr. J. W. Purcell, of the Walkerville Light & Power Co., Walkerville; Mr. P. M. Grimes, of the Ottawa Electric Co., Ottawa; Mr. Thos. F. Kelly, of the Dominion Power & Transmission Co., Hamilton.

Mr. Kelly was elected secretary of the meeting.

After a very interesting discussion regarding methods, rates and policies of the different companies represented, it was proposed by Mr. Kelly, seconded by Mr. McIntyre, and carried, that the Chairman be requested to write to members of the operating companies of the C.E.A. and ask them to furnish this Committee full information as to their rates, methods and other data that might prove interesting to any other company, for distribution to the operating companies represented in the C. E. A.

The information brought out by the discussion that was carried on throughout the evening was considered very valuable to the members present and it was the opinion of all that, providing the members of the Association that were employees of operating companies, co-operate with this Committee in its work, it would be a great help to the Association in general.

After a hearty vote of thanks offered to the Chairman for the interest he had taken in the formation of this Committee and the entertainment he provided, the meeting adjourned.

The Chairman, Mr. Creed, sent out quite a number of letters asking for information as to methods of securing business and received replies from thirty companies. The information received is tabulated below.

No. of
Company.

1. Wholesale. All power generated sold in five large blocks.
2. Wholesale. All power generated sold in large blocks. Has commercial engineer who assists company that retails the electricity.
3. Wholesale. Not advertising at present.
4. Has not advertised nor employed solicitors, nor letters for new business during past year.
5. Use solicitors, satisfactory, other question not answered.

6. Solicitors. Display both, contract department, system of circulars and lierature which are followed up. No newspaper advertising. House to house canvass.
7. Up to its capacity of plant. Not looking for new business at present.
8. Business coming as fast as they can take care of it, no opposition. No advertising.
9. Are enlarging plant. No advertising at present.
10. Getting ready for active campaign during coming year but have just appointed a general sales agent to organize the department for new business.
12. Display room. Newspaper advertising, solicitors. Think display room the strongest feature.
13. Wholesale. Large power in blocks.
14. Take care of what customers you have and new business will come. come.
15. Capacity of plant contracted for.
16. No solicitors, circulars with monthly invoices. Samples of devices in office.
17. Solicitors; some advertising.
18. Not much detail, but they advertise. Have display room.
19. Some advertising.
20. Wholesale.
21. Solicitors. Newspaper advertising, follow-up letters.
22. Solicitors. Newspaper advertising, special sign campaign.
23. Solicitors. Other questions not answered.
24. Wholesale.
25. Answer later Sec. 28.
26. Wholesale—solicitors.
27. Solicitors. Other questions not answered.
28. Solicitation by employees. Demonstrations at public functions.
29. Up to capacity of plant; are enlarging.
30. Changing plant. Have not solicited nor advertised.
31. Solicitation by employees. Newspaper advertising.
32. Solicitor.

Summary.

Seven sold their output wholesale; five are enlarging their plants and not now looking for new business; four are making no efforts; two have made special sign campaigns with good results; one has made house to house canvass and found the results good; three have used circulars with follow-up letters; one has created a department for new business which will be under way during this year; seven use newspaper advertising with various successes; five use display rooms; one demonstrates at public functions and says it is very successful; eleven use solicitors and most of them report good results.

Mr. Creed resigned about April 15th and Mr. Purcell was asked to finish the term as chairman of this Committee. The companies did not send information in freely, which was perhaps due to the form in which

it was asked for. We think that in taking up work of this kind hereafter the information should be asked for in the form of questions with blanks left to be filled in. It is the opinion of this Committee that this work should be continued.

Respectfully submitted,
J. W. Purcell (Chairman),
Eugene Creed,
W. H. McIntyre,
P. H. Grimes,
Thos. F. Kelly.

The President: It is perhaps unfortunate that time will not allow a free discussion of this report, because it is one of great importance. Personally I would like to see the Committee continue in order that more data may be gathered, and next year it might be allotted a place on the programme which would permit of it being properly discussed.

Central Station Statistics

REPORT OF CENTRAL STATION STATISTICS COMMITTEE

W. A. BUCKE (Chairman), Toronto.
A. L. MUDGE, Toronto. W. L. ADAMS, Niagara Falls.
G. N. THOMAS, Toronto.

This year the forms sent out for the purpose of obtaining statistical information were revised, the revision consisting in the rearrangement of the questions in an attempt to make the purpose of the enquiry clearer in itself to the official who would fill out the same. Also, questions were put in to cover additional information. The main additions consist in:—

(1) Complete information on transmission lines.

(2) Separation of information on transmission lines from that on distribution lines.

(3) Detailing of the information in connection with public and commercial lighting, especially with regard to the use of metallic filament lamps.

(4) The separation of the ''railway loads'' carried by central stations from the ''general loads'' so that more efficient information can be given with regard to those stations serving railways.

(5) Analysis of operating costs.

As regards the success of the information gathered in connection with these additional points, this has been good so far as the transmission lines are concerned and fair in connection with the other points.

The number of returns sent in this year, allowing for a few which could not be made use of owing to the information being insufficient, shows an increase of 13 per cent. This increase has not kept pace with that of preceding years. This may be partly due to the affiliation with the National Electric Light Association. Also, a secondary reason may be the increase in the amount of work in filling in the forms. This latter reason raises the question as to whether it would not be better to make out the forms covering the exact questions which will be utilized in the published statistics. At the same time, it must be borne in mind that had efficient replies been given to all the questions on the forms made out this year, all such replies would have been utilized, but in some cases these were deficient, either in quality or quantity, and it was not deemed desirable to use the information given.

It is to be noted that one of the largest companies in Canada has given very full replies to the questions asked and it is to be hoped that more of the large companies will follow their example.

Over 500 enquiries were sent out. This shows that, with sixty-eight useful replies received, only about 17 per cent. made their returns.

In connection with the meter rates for power and light, it will be noticed that discounts have not usually been given on the table, although it must be well known that many companies give discounts. Nearly all the figures sent in have had their discounts allowed for, the reason being that a discount is given in order to secure prompt payment from the consumer, and where it is exacted is intended to be utilized to pay for the labour and trouble of collecting.

In connection with the station records, it is noticed that many companies reply in the affirmative to the question as to whether they meter their generated power and out-going power, but they are unable to give the necessary figures. There is still only a comparatively small percentage who profess to keep the necessary records. This is unfortunate, as it means that the central stations are being run without any exact knowledge as to what they are doing, or what improvements can be made in the efficiency of the station.

In connection with the public lighting, a change was made in the form of the questions covering the size of incandescent lamps. Formerly the size was given in candle power, but this year it has been given in watts or amps (the voltage being also given), for the reason that, as the watts per candle power vary very considerably, the real test of the size of the lamp is its wattage.

A marked feature of this year's returns is the large increase in the use of the metallic filament lamps, both for public and commercial lighting.

Comparing the present report with those of previous years, there is a strong indication that the flat rate system of charging for power is steadily going out of use, and that charging by meter on the sliding scale basis is becoming more general. Incidentally, perhaps the general use of the flat rate system in the past has been responsible very largely for the non-metering of the station power generated and the station output. Possibly the passing of the pure flat rate system will mean the more general use of station meters.

We have been carrying on the work of gathering statistics from Central Stations for several years at considerable expense to the Association, and without obtaining any information whatever from the majority, and in a great many other cases, indefinite information; and it therefore appears doubtful whether it is advisable to continue the work as carried on at present. Unquestionably, if information could be obtained from all the companies it would be of immense benefit to all. This fact is realized in many countries, where the government compel central stations to furnish information.

Under all the circumstances, this Committee would suggest that the Executive look thoroughly into the question of carrying on the work that has been handled by this Committee, in some other and better way than it has been carried on in the past, before further expenditures are incurred.

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL GENERATING STATIONS.

CAPITAL EXPENDITURE AND EQUIPMENT.

No.	Location of Station.	Population Served.	Authorized Capital.	Capital Issued.	Bond Issue.	System Phase.	Voltage.	Frequency.	Class of Station.	K. W. Capacity.	Character of Load.	K. W. per Capita Served.	Total Issued Capital per Capita.	Capital per K.W. Install'd	Owners.
1	B.C.	......	....	....	....	......	2,300	....	W & S	400	......	...	....	....	Co.
2	N.S.	......	....	....	....	......	110	D C	S	17	......	....	....	....	Co.
3	Ont.	......	....	....	....	2	2,200	60	S	75	L	....	....	....	Co.
4	Ont.	500	....	....	....	1	1,000	100	S	50	......	·1	....	....	Mun'y
5	Ont.	740	4,000	2,500	....	1	1,100	133	S	30 AC 23 DC	L	·075	3·38	45·4	Mun'y
6	Ont.	800	....	....	....	2	1,100	60	S	72	L	·09	....	....	Private
7	P.E.I.	900	15,000	10,000	....	1	2,080	125	W	30	L	·033	11·11	333·3	Co.
8	Ont.	900	40,000	30,200	....	3	2,300	60	W	325	L & P	·36	33·5	93	Co.
9	Ont.	900	40,000	12,100	....	2	2,200	....	W	150	L	·17	13·6	80·6	Co.
10	Ont.	900	....	....	....	2	2,080	133	......	175	L	·083	...	....	Co.
11	Ont.	1,000	40,000	30,000	....	......	110/220	D C	S	35	L	·035	30	856	Co.
12	Ont.	1,200	....	....	....	1	1,000	125	S	45	L	·037	....	....	Private
13	Ont.	1,200	....	15,000	....	3	2,200	....	W	200	L & P	·167	13·6	75	Co.
14	Ont.	1,300	....	14,000	....	......	....	....	G	....	L	....	10·7	....	Private
15	Alta.	1,500	32,000	28,470	....	3	2,300	60	S & W	210	L	·14	19	135·9	Mun'y
16	N.B.	1,500	....	....	....	1	2,200	....	S	126	L & P	...	....	....	Co.
17	Man.	1,500	....	....	....	......	220	....	S	85	L	....	....	....	Co.
18	Alta.	1,500	....	....	....	3	2,300	60	S	80	......	·053	....	....	Mun'y
19	Ont.	1,600	....	....	....	3	2,080	60	W	150	L	·094	....	....	Co.
20	Ont.	1,800	20,000	10,750	....	3	4,400	60	W	100 AC 100 DC	L & P	·011	5·98	53·75	Co.
21	Ont.	1,800	80,000	....	....	3	10,000	....	W	250 105*	L & P	·0198	....	....	Co.
22	Ont.	2,000	....	....	....	2	1,100	60	S	72	L	·036	....	....	Co.
23	Alta.	2,000	56,000	....	50,000	3	2,350	60	S	370	L & P	·185	25	135	Mun'y
24	N.B.	2,000	40,000	21,000	....	......	106	D C	S	90	L	·045	10·5	234	Co.

25	Ont.	2,700	....	24,000	....	......	1,040	....	S	120 40	......	·059	8·9	150	Co.
26	Ont.	2,800	20,000	18,400	....	......	1,100	....	S	75	......	.0268	6·56	246	Co.
27	Ont.	3,000	25,000	20,000	....	2	2,200	60	S	290	L & P	·96	6·66	69	Co.
28	Que.	3,000	....	....	....	3	3,000	60	W	75	L	·025	....	....	Co.
29	B.C.	3,500	....	....	....	3	2,200	60	G W	850	L & P	·243	....	....	Mun'y
30	Que.	3,500	72,000	....	....	3	2,200	60	W	500	L & P	·143	....	....	Mun'y
31	Que.	3,500	40,000	34,600	....	2	2,200	133	W	225	L	·064	9·9	154	Co.
32	Ont.	3,500	75,000	20,000	....	......	110	...	Purch'd	75	L	·022	5·7	267	Co.
33	Ont.	3,900	60,000	60,000	....	......	110	60/120	S & G	180	......	·046	15·4	334	Co.
34	Que.	4,000	....	....	....	2	2,300	60	W	260	......	·062	....	....	Mun'y
35	Ont.	4,000	....	....	....	2	2,300	60	Purch'd	240	L & P	·06	....	....	Mun'y
36	Ont.	4,000	80,000	60,000	....	3	2,200	60	W	500	L & P	·125	15	120	Co.
37	Que.	4,000	....	30,000	....	2	2,300	60	W	300	......	·075	7·5	100	Co.
38	Ont.	4,200	....	....	....	1	1,080/104	125	S	320	L	·077	....	....	Mun'y
39	Ont.	4,500	....	......	....	1	2,000/104	133	S	120	...	·026	....	...	Co.
40	N.B.	5,000	....	....	65,000	2	1,000	60	S	325	L & P	·065	13	200	Mun'y
41	N.S.	6,000	100,000	100,000	25,000	5 Wire	125/500	D C	S	450	L & P	·075	20·8	278	Co.
42	Ont.	6,040	....	550,000	....	3	2,400	60	S	1,875	L & P	·31	91·4	294	Mun'y
43	Sask.	7,000	....	....	117,000	3	2,200	60	W	335	L & P	·048	16·7	350	Mun'y
44	Ont.	7,000	....	....	325,000	2	1,200	66	W	960	L & P	·137	46·43	339	Mun'y
45	Ont.	7,000	....	....	80,000	2 & 1	2,300	60	S	450	L & P	·064	11·43	178	Mun'y
46	Ont.	8,000	300,000	263,000	....	3	550	60	W	800	L & P	·1	32·9	329	Co.
47	Ont.	9,000	....	....	79,985	3	2,200	60	S	400	L & P	·044	8·88	199·7	Mun'y
48	Que.	9,000	50,000	50,000	35,000	3	2,300	60	S	455 746*	L & P	·133	9·44	165	Co.
49	Ont.	10,000	200,000	134,320	100,000	2	2,300	60	S & G	400 AC 250 DC	L. P & R	·065	23·4	360	Co.
50	Ont.	10,000	....	....	....	3	3,000	60	W	2,000	L & P	·2	....	....	Co.
51	Que.	11,000	200,000	115,000	38,000	3	2,500	60	S & W	450	L & P	·041	13·95	341	Co.
52	Ont.	12,000	....	147,000	....	3	2,200	60	S	600	L & P	·05	12·25	245	Mun'y
53	Ont.	12,200	....	....	....	3	2,200	60	Purch'd	90	L	.0074	...	...	Mun'y
54	P.E.I.	12,000	....	55,000	15,000	1	1,100	125	S	600	L	·05	5·83	116·6	Co.

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL GENERATING STATIONS.

CAPITAL EXPENDITURE AND EQUIPMENT.

No.	Location of Station	Population Served.	Authorized Capital.	Capital Issued.	Bond Issue.	System Phase.	Voltage.	Frequency.	Class of Station.	K. W. Capacity.	Character of Load.	K.W. per Capita Served.	Total Issued Capital per Capita.	Capital per K.W. Install'd	Owners.
55	Alta.	14,000	....	....	....	2	2,300	60	S	938	L & P	·067	....	....	Mun'y
56	Sask.	15,000	....	....	....	2	2,200	60	S	850	L & P	·056	....	....	Mun'y
57	Ont.	15,000	....	....	68,967	1	1,040	125	W & S	300 AC 150 DC	L & P	·03	4·59	153	Mun'y
58	Ont.	16,000	....	....	....	3	2,200	60	W	1,600 1,600*	L. P & R	·2	....	....	Mun'y
59	Que.	18,000	250,000	250,000	....	3	2,200	60	W	1,400	L & P	·078	13·9	179	Mun'y
60	Ont.	18,000	....	....	....	3	6,600	60	W	1,200	L & P	·066	....	....	Co.
61	Que.	21,000	300,000	300,000	....	3	10,000 2,200 600	60	W	1,900 AC 950 DC	L. P & R	·136	14·25	105	Co.
62	N. S.	23,000	2,000,000	1,359,000	....	2	2,200/500	60	S	600 AC 1,150 DC	L. P & R	·076	59	775	Co.
63	Ont.	25,000	....	....	....	3	2,300	60	S	1,100	L. P & R	·044	....	....	Co.
64	Alta.	40,000	....	....	732,732	3	2,300	60	S & S	2,375 AC 1,400 DC	L. P & R	·094	18·3	195	Mun'y
65	N. S.	50,000	1,500,000	1,400,000	600,000	1 & 2	2,200	60	S	1,800	R	·036	40	1112	Co.
66	Alta.	50,000	....	....	....	3	2,700 559	60	S & W	2,800 AC 2,400 DC	L. P & R	·104	....	....	Mun'y
67	Ont.	140,000	25,000,000	10,250,000	6,488,000	3	2,400	66⅔	W & S	36,250 AC 4,600 DC	L. P & R	·291	120	410	Co.
68	B. C.	175,000	12,500,000	12,000,000	8,845,000	3	2,200	60	W & S	22,000	L. P & R	·125	119·5	948	Co.

* Purchased Power.

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL GENERATING STATIONS.

DISTRIBUTION SYSTEM.

No.	Transmission Lines						Transmission Transformers		Distributing Line						
	Number	Total Length in Miles	Voltage	System Phase	Material (line)	Insulators	Trans-formers, number each end	Total K.W. Capacity Step Up or Step Down	Total Length	Under-ground or Over-head	Voltage	System Phase	Trans-former Number	Total K.W. Capacity	Grounded Secondaries
1	....	....	......	....	......	....	....	....	....	....	....	......	......	......	No
2	....	....	......	....	......	....	....	....	....	....	....	.....	......	......	....
3	1	13	4,400	2	Cu.	DP. Glass	1	33	....	0	....	......	28	70	No
4	....	....	.....	....	......	....	....	....	....	....	....	......	......	.....	....
5	1	2	1,100	1	Cu.	SP.	....	....	1½	0	110	......	8	11	No
6	....	....	......	....	......	....	....	....	....	....	110	2	19	100	No
7	1	2½	2,080	1	Cu.	Glass	....	....	1	0	110	1	14	......	No
8	1	2¾	2,200	3	Cu.	Glass	....	....	2	0	110/220	3	16	155	No
9	1	6	2,200	2	Cu.	Glass	6	....	6	0	....	2	6	37	No
10	1	2½	2,080	2	Cu.	DP. Glass	....	....	1¾	0	104	2	12	45	No
11	....	....	......	....	......	....	....	....	....	....	....	......	......	......	....
12	....	....	......	....	......	....	....	....	6	0	....	....	......	......	No
13	4	20	2,200	3	Cu.	Glass	....	....	5	0	110	......	15	......	Yes
14	....	....	......	....	......	....	....	....	....	....	....	......	......	.....	....
15	1	8	6,600	3	Cu.	....	3	90	0	....	....	......	20	100	No
16	....	....	......	....	......	....	...	....	....	....	....	.....	15	39	No
17	....	....	....	...	......	....	....	....	6	....	220	......	......	......	....
18	1	6	2,300	3	Cu.	DP. Glass	....	....	8	0	2,300	......	14	70	No
19	1	4½	2,080	3	Cu.	DP.	....	....	4	0	104	......	22	150	No
20	3	21	4,400	3	Cu.	P.	....	....	5	0	110	3	15	......	....
21	2	14	10,000	3	Cu.	Umbrella	4	....	5	0	110	3	40	......	....
22	....	....	......	....	Cu.	Glass	...	....	4	....	....	......	15	40	No
23	...	....	......	....	......	....	....	....	6	....	....	.....	......	......	....
24	....	....	......	....	......	....	....	....	4	0	106	D.C.	......	.....	....
25	.. .	...	......	....	.....	....	....	....	....	....	....	......	......	......	....

27	4	4·45	2,300	3	Cu.	Porc.	....	....	....	....	....	....	43	245	Yes
28	2	9	3,000	3	Cu.	....	....	....	4	....	....	....	20	17·5	No
29	1	2	2,200	3	Cu.	DP. Glass	....	....	8	0	....	....	75	450	No
30	....	....	....	....	....	....	....	....	....	....	110	....	33	465	....
31	3	12	2,200	2	Cu.	DP. Glass	....	....	....	....	....	....	38	149	....
32	....	....	....	....	....	....	....	....	....	....	110	....	15	75	Yes
33	....	....	....	....	....	....	....	....	3	0	....	....	20	67	Yes
34	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
35	....	....	....	....	....	....	....	....	8	0	2,200	....	38	333	No
36	1	3½	2,200	3	Cu.	....	....	....	4½	0	2,200	....	54	320	Yes
37	....	14	2,300	2	Cu.	Glass	....	....	....	....	....	....	75	195	Some
38	....	....	....	....	....	....	....	....	....	....	....	....	64	....	No
39	....	8	2,000	1	Cu.	DP. Glass	....	....	10	0	....	....	....	....	No
40	....	....	....	....	....	....	....	....	19½	0	1,100	....	50	350	No
41	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
42	2	4	2,400	3	Cu.	DP. Glass	....	....	6	0	....	....	84	534	Yes
43	....	....	....	....	....	....	....	....	20	0	....	....	97	349	Starting
44	1	20	22,000	3	Cu.	No. 64 Victor	8	1,200	....	....	....	....	....	....	No
45	....	....	....	....	....	....	....	....	16	0	2,300	....	54	365	Yes, through 150 V. Light Arrester
46	1	13½	11,000	3	Cu.	Locke 22,000 V	6	810	18	0	1,100	....	108	....	No
47	....	....	....	....	....	....	....	....	....	....	....	....	69	497	....
48	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
49	....	....	....	....	....	....	....	....	37	0	2,300 110/220	....	150	524	No
50	1	6	10,000	3	Cu.	Glass	12	1,750	4 ·57	0 U	2,000	....	40	300	Yes
51	....	5	....	....	....	....	....	....	12	0	....	....	....	....	No
52	4	32	2,200	3	Cu.	DP. Glass	....	....	12	0	....	....	68	489	No
53	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
54	....	....	....	....	....	....	....	....	5	0	....	....	80	....	No

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL GENERATING STATIONS.

DISTRIBUTION SYSTEM.

No.	Transmission Lines						Transmission Transformers		Distributing Line						
	Number	Total Length in Miles	Voltage	System Phase	Material (line)	Insulators	Transformers, number each end	Total K.W. Capacity Step Up or Step Down	Total Length	Underground or Overhead	Voltage	System Phase	Transformer Number	Total K.W. Capacity	Grounded Secondaries
55	2	....	2,300	2	Cu.	Glass	....	....	....	....	....	......	......	......	No
56	...	....	......	....	... ..	....	....	....	....	....	....	......	94	784	... .
57	....	....	....	....	......	....	....	. ...	....	....	....	......	75	450	Some
58	2	6	25,000	3	Al.	... ...	4	2,984	157	0	....	......	28	1,150	No
59	....	....	......	....	......	....	....	....	31	0	....	......	178	1,663	Some
60	2	10	6,600	3	Cu.	....	6	1,500	20	0	2,300	... ..	91	1,800	No
61	3	9	10,000	3	Cu.	Porc.	8	2,000	36	0	2,200	......	230	520	Yes
62	1	14	11,000	3	Cu.	....	4	1,000	25	0	2,200	....	139	973	No
63	....	....	.....	....	......	....	....	....	....	....	....	......	......	.....	....
64	...	....	......	....	......	....	....	....	22	0	....	......	240	2,075	Yes
65	....	....	......	....	......	....	....	....	53	0	... .	.. ...	290	1,812	Some
66	....	....	......	....	......	....	....	....	....	....	....	......	......	......	....
67	....	....	......	...	......	....	....	....	....	....	....	......	......	......	....
68	15	200	38,000	3	70 Cu. 130 Al.	A. B. Co. No. 9416 Porc.	109	49,000	400	0	2,200	......	2,600	19,000	Neutral grounded on 3 wire secondary

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL CENTRAL STATIONS.

PUBLIC LIGHTING

No.	Arcs			Incandescents						Current Transformers		Price in Dollars per Annum				Metered in Cents per K.W.H.	
												Arcs		Incandescents			
	Number	Amps.	Hours Burning	Carbons Number	Metallic Filam't Number	Voltage	Amps, Watts or Candle Power	Series or Multiple	Hours Burning	Number and Total K.W Capacity	Amps.	Carbon	Magnetite	Carbon	Metallic Filament	Arcs	Incandescents
1	....	....	......	......	....	....	....	..	......	......	....	70	50	....	....	....	10-15
2	...	....	.....	......	....	....	....	..	......	......	....	....	..	....	....	....	....
3	....	....	......	57 27	....	....	32 c.p. 30 c.p.	..	......	......	....	....	..	10.20 per 32 c.p.	....	....	....
4	....	..	......	......	....	....	....	.	......	......	....	...	..	....	....	....	...
5	7	....	......	......	....	....	....	..	.....	......	....	72	..	....	....	....	....
6	....	....	......	......	71	....	32 c.p.	S	1,800	1–8·8	3·5	....	..	....	....	....	....
7	....	....	......	24	....	110	60 w.	M	3,000	......	....	....	..	3.	....	....	....
8	...	....	......	......	41	....	6·6	S	2,160	1	6·6	....	..	....	12.	....	....
9	13	5	all dark 2,130	......	....	....	....	.	2,000	......	....	45·11	..	5.	....	....	....
10	....	....	......	900	200	104 104	20 w. to 75 w. 20 w. to 60 w.	M	4,380	......	....	....	..	3.60	3.60 per 40 w.	....	10
11	....	....	.....	......	5 700	42 110	75 w. 25 w. to 250 w.	S M	400 2,200	......	....	....	..	18.00	10 50 per 60 c.p.	...	....
12	....	....	......	49	... 7 2100	 110	3·5 a.	S S M	1,500 1,500	1	3·5	....	..	....	....	...	...
13	14 12	9·5 5·5	3,650 3,650	......	....	....	....	..	......	....	....	41	..	....	....	....	....
14	....	....	.....	900	43	110 110	50 w.	M M	all night	.....	....	....	..	7.30 per 16 c.p.	11.00	....	....
15	16	6	moonl'ht sch.	1,500	...	104	....	M	......	......	....	75	..	....	....	....	20
16	1	....	......	350	....	110	....	S	......	.. ...	....	....	.	5.00	....	....	....
17	7	3·5	......	33	....	220	120 w. to 200 w.	M	..... .	......	....	10c. per lamp hour	..	1¾c. per lamp hour per 32 c.p.	3c. per lamp hour per 50 c.p.	....	....
18	21	6·6	1,000	.....	6	72	80 w.	S	1,000	.....	....	91.80	..	....	14.00	....	....
19	6	6	3,650	28	....	104	50 w.	M	3,650	.. ..	....	50	.	15.00 per 50 c.p.	....	....	....
20	11	12·5	3,650	.... .	....	....	....	..	......	......	....	65	..	....	... .	....	....

21	...	....	......	40	...	....	....	S	2,000	......	...	....	..	....	......	....	....
22	....	....	.....	57	....	52	4 a.	S	1,000	......	....	....	..	13.50	....	....	....
23	15	6·6	1,800	40	....	110	·9 a.	M	3,650	......	....	100	..	15.00	......	....	....
24	....	...	......	......	....	....	....	..	......	......	....	....	..	....	....	....	...
25	....	..	......	.....	118	....	50 w.	M	till midn't	......	....	....	..	....	12.20	....	....
26	....	....	......	......	....	....	....	..	......	......	....	....	..	....	....	....	....
27	...	....	......	......	....	....	....	..	......	......	....	....	..	....	....	....	1st 30 units 12c. next 60 units 8c. over 90 units 4c.
28	....	...	......	......	....	....	....	..	......	......	....	...	..	4.00	4.00 per 40 w.	....	10
29	5 50	6·6 6·6	moonl'ht sch.	16	... 3	110 110	30 c.p. 250 w.	M M	all night	1–8	1	....	..	....	....	...	5.5
30	...	...	.....	4,000	... 60 70 70	110	.... 80 c.p., 5·50 a. 60 c.p., 5·50 a. 40 c.p., 5·50 a.	M S	......	1–16	5·5	....		....	12.50 per 60 c.p.	....	....
31	...	....	......	3,000	....	100	....	M	4,725	......	...	....	..	3.00	3.00	....	10
32	....	....	......	......	....	....	....	..	......	......	....	....	..	....	....	....	....
33	38	6·6	3,500	.....	10	110	80 w.	S	3,500	......	....	55	..	22.00	25.00	....	12·6
34	....	....	......	......	....	....	....	..	......	......	....	...	..	....	....	...	....
35	43	6·6	all night	......	22	12	80 w.	S	all night	1	6·6	....	.	....	....	....	....
36	43	6·6	......	23	...	104	600 w.	M	......	......	....	40	..	....	....	....	8
37	39	....	3,240	2,000	 500	110 112	.... 40 w.	M M	4,320 2,880	2–35	6·6	55	..	....	....	...	....
38	....	...	......	......	...	....	....	..	.....	......	....	50	..	20.00	....	....	....
39	26	6·6	1,500	200	....	104	56 w.	..	......	......	....	....	..	....	....	....	....
40	6	6·6	......	80 4,000	60	25 112	100 w. 60 & 100 w.	S M S	3,000 3,000	......	...	....	..	....	....	....	12
41	70	6·5	3,500	20	....	110	60 w.	M	......	2–12	6·5	39	..	....	......	10	....
42	78	6·6	1,750	......	....	....	....	..	......	3	6·6	75	..	....	....	....	....
43	....	...	.....	420	....	250	60 w.	M	......	......	....	....	..	10.00 per 16 c.p.	....	...	....
44	48	6·6	......	50	....	....	6·6 a.	..	contin'ly	2–15	6·6	....	..	....	....	....	....
45	53	6·6	1,249	......	61	....	40 w.	S	3,620	2	6·6	45	..	....	20.00	....	....
46		6·8	.....	......	....	....	....	..	......	3	6·6	50	..	....	....	....	...

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL CENTRAL STATIONS.

PUBLIC LIGHTING

No.	Arcs			Incandescents						Current Transformers		Price in Dollars per Annum				Metered in Cents per K.W.H.	
												Arcs		Incandescents			
	Number	Amps.	Hours Burning	Carbons Number	Metallic Filam't Number	Voltage	Amps, Watts or Candle Power	Series or Multiple	Hours Burning	Number and Total K.W. Capacity	Amps.	Carbon	Magnetite	Carbon	Metallic Filament	Arcs	Incandescents
47	90	6·6	3,500	......	....	....	....	..	......	2–28	6·6	60	..	....	....	....	....
48	13	7·5	4,000	80	20	110	40 w. 112 w.	M	4,000 4,000	......	....	65	..	12.00	12.00	....	....
49	..	....	......	......	....	....	....	..	......	......	....	....	..	....	......	....	....
50	230	6·6	3,600	10	....	110	112 w.	M	3,600	3–120	6·6	90	..	16.00 per 32 c.p.	....	....	....
51	...	....	.. ..	......	....	....	....	..	......	......	....	....	..	....	....	....	....
52	82	6·6	3,030	65 30	....	105	120 w. 450 w.	S M	3,000 3,000	2–50	6·6	70	.	....	.... .	4	4
53	141	6·6	all night	......	5	113	6·6 a.	S	all night	3–90	6·6	54·75	..	....	....	....	....
54	76	6·6	2,800	......	40	72	40 w.	S	2,800	2	6·6	73	..	20.00	....	...	....
55	53	6·6	4,000	......	160	25	100 w.	S	4,000	2–37	6·644	65	..	....	12.00	..	....
56	70	6·6	1,000	......	....	....	....	..	.....	......	....	....	..	....	....	11	11
57	1 F 99 C	7 9·6	3,000 2,300	......	....	....	....	..	......	......	....	60	..	....	.... ..	4	10
58	18	....	3,000	400	....	110	3·5 a.	M	.....	......	....	48	..	....	....	....	6
59	87	6·6	all night	. ....	250	....	6·6 a, 75 w.	S	all night	3	6·6	60	..	....	10.00	...	...
60	....	...	.....	......	....	....	....	..	......	......	...	....	..	....	......	....	....
61	70	6·5	......	23	....	100	....	S	......	......	....	36	..	2.50 per 16 c.p.	2.50 per 25 c.p.	7·2	7·2
62	24 S 1 M	6·6 110 V.	3,200	469	....	....	6·6 a, 40 w.	S	3,200	2–46	6·6	90·20	..	....	19.09 per 32 c.p.	12 less 5 to 25% disc.	
63	....	....	.... .	......	....	....	....	..	......	......	....	....	..	....	....	...	....
64	170	6·6	3,650	170	....	....	....	..	......	4–100	6·6	67·50	..	....	....	....	....
65	369	7·5	moonl'ht sch.	5	2	....	7·5 a, 235 w. 7·5 a, 80 w.	S S	moonl'ht sch.	6–377	7·5	....	..	....	....	....	....
66	214 50 M	6·6 6·6	......	......	59	....	....	..	......	6–50 lamp	6·6	79	79	9.00	15.00	....	....
67	....	....	.... ..	.....	...	...	....	.	....	......	....	...	..	.. ..	....	....	....
68	1450	7·5	4,327	124	.. 565 117	110 11·3 110	120 w. 75 w. 55 w.	M S M	4,327 4,327 4,327	19 100 lamp	7·5	38	..	All Metered: 1st 50 units 9; next 50 " 8; next 300 " 7·2; next 300 " 6·4	next 300 units 5·6; next 500 " 4·8; next 500 " 4; over 2,000 " 3·2		

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL CENTRAL STATIONS.

COMMERCIAL LIGHTING

Number	ARCS			INCANDESCENTS			PRIVATE LIGHTING						BUSINESS LIGHTING						
							Price in dollars per annum		Metered in cents per K. W.H.	Price in dollars per annum		Metered in cents per K. W.H.	Price in dollars per annum			Metered in cents per K. W.H.	Price in dollars per annum		Metered in cents per K. W.H.
							Arcs			Incandescent Lamps				Arcs			Incandescent		
	Carbon No.	Mag-ne-tite No.	Amps.	Carbon reduced to 16 c.p. equivalent	Metallic Filam't reduced to 25 w. equ'al't	Signs reduced to 4 c.p. equivalent	Carbon 4 amp. equiv.	Magn'tite 4 amps. equiv.		Carbon 16 c.p. equiv.	Metallic Filament 25 w. equiv.		Signs	Carbon 4 amp. equiv.	Magn'tite 4 amp. equiv.		Carbon 16 c.p. equiv.	Metallic Filament 25 watt equiv.	
1	...	..	....	......	....	......	....	....	....	....	.....	....	..	....	....	....	......	....	.....
2	...	..	....	......	....	......	....	....	....	....	......	....	..	....	....	....	4 for $25 up to 10 $5 each, above $4 each	....	15
3	....	..	....	......	....	......	....	....	....	6.24	......	10	..	....	....	....	6.24	....	10
4	....	..	....	......	....	......	....	....	....	....	......	....	..	....	....	...	......	....	.....
5	2	..	6	800	50	......	....	....	....	3.60	......	12	.	....	....	....	3.60	....	12
6	....	..	....	1,500	200	......	....	....	....	....	......	10	..	....	....	....	......	...	10
7	....	..	....	350	50	......	....	....	...	3.00	3	8	..	....	....	....	4.50	2.50	10
8	....	..	....	1,000	500	......	....	....	...	....	.....	8	..	....	....	....	......	....	8
9	....	.	....	25	...	......	....	....	....	4.20	......	....	..	....	....	...	5.40	...	.....
10	....	..	....	900	225	......	....	....	....	3.60	3.60 per 40 w.	10	..	....	....	....	3 60	3.60 per 40 w.	10
11	2	..	5	400	300	......	....	....	...	4 00	6.00	12–15	..	35.00	....	12	......	5.20	12
12	....	..	....	......	....	......	....	....	....	4.00 – 6.00	4.56	10	..	....	....	10	4–6	4–6	10
13	....	..	....	1,200	....	......	....	....	....	....	.....	....	..	....	....	...	......	....	....
14	....	..	....	......	...	......	....	....	....	....	7.30	....	..	....	....	....	......	7.30	.....
15	....	..	....	......	....	......	...	....	...	....	......	20	..	....	....	....	......	....	20
16	....	..	....	......	....	......	....	....	....	....	......	15	..	....	....	....	......	....	15
17	1	..	3·5	2,500	100	20	....	....	....	....	......	16	..	....	....	16	......	....	16
18	....	..	....	200	250	200	...	....	....	12 00–7.50	12.50 per 60 w.	100–17 150–15 200–13 over–11	..	....	...	....	12.00 to 7.50	12 50 per 60 w.	100–17 150–13 200–13 over–11
19	....	..	....	1,500	....	......	....	....	...	2.00	......	...	..	....	....	....	3.00	...	....
20	3	..	6	7,000	500	.....	91.25	....	...	3.65	......	....	..	91.25	...	....	2.50	2.50	.....
21	....	..	....	1,700	200	......	....	....	....	....	......	...	..	....	....	....	3 50	....	.....
22	....	..	....	1,200	....	......	....	....	....	5.00	.....	12	..	....	....	....	5.00	....	12

23	....	..	....	3,000	....	....	....	....	....	....	....	. .	..	....	....	....	....	....	....
24	....	..	...	2,600	...	2	....	....	....	4 for $22 above $3.50 each	....	8–14	..	....	....	12	5 for $35 above $5 each	....	12
25	10	..	6·6	3,000	500	100	....	....	10	....	....	8–10	..	....	...	8–10	....	....	8–10
26	...	..	....	2,000	. .	....	....	....	....	....	....	....	..	....	....	....	....	....	7–15
27	....	..	...	6,000	150	100	....	....	....	....	....	1st..30-15 next 60-10 over..90-5	..	same as private					
28	....	..	....	1,600	100	....	....	....	....	4.00	....	....	..	....	....	10	4	....	....
29	....	..	....	6,000	....	800	....	....	....	....	....	....	.96	....	....	....	....	....	....
30	....	..	....	1,500	500	....	....	....	....	....	....	....	..	....	....	....	....	....	....
31	....	..	....	3,000	....	....	....	...	..	.3.00	2.40	10–75	..	....	....	....	6.00	4.80	10–75
32	....	.	....	2,500	45	....	...	....	....	....	....	10	..	....	....	....	....	....	....
33	....	..	....	3,000	....	40	..	....	. .	4.80 – 7.20	....	12·6	3.60	....	....	12·6	....	....	12·6
34	....	..	....	2,000	....	....	....	....	....	3.35 – 2.30	....	....	..	....	....	....	3.60-2.35	...	....
35	1 3 F	...	6 10	....	....	....	....	....	9	....	....	9, with 10 p.c. disc. for 500 K. W.H. per month or over	..	....	....	9, with 10 p.c. disc. for 500 K. W.H. per month or over	....	....	9, with 10 p.c. disc. for 500 K. W.H. per month or over
36	12	..	6·6	4,300	1,700	320	....	....	....	4.16	4.16	10	4	....	....	8	4.16	4.16	6
37	6	..	....	200	75	....	36	....	....	3.00	3.00 per 40 w.	....	..	....	30	....	....	4.00 per 40 w.	....
38	...	..	....	....	....	....	...	....	12	....	....	12	..	....	....	....	....	....	....
39	....	.	...	....	....	....	....	....	....	....	....	....	..	....	....	....	....	....	....
40	....	..	....	....	....	....	....	....	....	....	....	....	..	....	....	12	....	....	12
41	....	..	....	6,500	....	....	....	. .	16	with discount 1st 2.00..12½ p.c. next 3.00..25 p.c. next 6.00..33 1-3 over 11.00..50 p.c.	....	10½	..	....	. .	10½	....	....	10½
42	2 F 15	..	10 6	6,685	....	500	48	....	10	....	....	10 with dis.	..	48	....	10 with dis.	....	....	10 with dis.
43	8 F	..	....	8,000	....	....	....	....	10½	....	....	10½	..	...	....	10½	....	....	10½
44	. .	..	....	. .	....	....	....	....	....	2.16	....	8	..	....	....	....	2.64	....	....
45	...	..	....	....	....	....	...	....	....	....	....	....	..	....	....	....	....	....	....
46	2 F–25	.	6 6	8,000	500	....	....	....	9⅜	....	....	9⅜	..	. . .	....	9⅜	....	....	9⅜
47	80 8 F	..	6 13	10,000	....	200	...	....	....	....	....	8	6	....	....	8	....	....	8
48	15	..	7·5	8,900	....	48	36	....	11–10½ 10	....	....	11–10½ 10	..	36	....	11–10½ 10	....	....	11–10½ 10

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL CENTRAL STATIONS.

COMMERCIAL LIGHTING

Number	ARCS			INCANDESCENTS			PRIVATE LIGHTING: Price in dollars per annum: Arcs		Metered in cents per K.W.H.	Price in dollars per annum: Incandescent Lamps		Metered in cents per K.W.H.	BUSINESS LIGHTING: Price in dollars per annum			Metered in cents per K.W.H.	Price in dollars per annum: Incandescent		Metered in cents per K.W.H.
	Carbon No.	Magnetite No.	Amps.	Carbon reduced to 16 c.p. equivalent	Metallic Filam't reduced to 25 w. equ'al't	Signs reduced to 4 c.p. equivalent	Carbon 4 amp. equiv.	Magn'tite 4 amps equiv.		Carbon 16 c.p. equiv.	Metallic Filament 25 w. equiv.		Signs	Arcs: Carbon 4 amp. equiv.	Arcs: Magn'tite 4 amps. equiv.		Carbon 16 c.p. equiv.	Metallic Filament 25 watt equiv.	
49	830 5 F	..	6 6–12	20,000	2,000	1,275	....	....	8	....	......	8	6	...	....	8	.....	....	8
50	...	..	....	1,000	....	......	....	....	....	4.80	......	10	..	....	....	...	4.80	...	10
51	13	..	6 6	12,500	600	200	60	....	12	3 to 10	.....	12	..	....	....	....	......	....	.....
52	35 4 F	..	4 5 9	......	....	......	....	....	8	....	......	8–9	..	....	....	8	......	....	8–9
53	......	..	......	......	....	......	....	....	....	....	......	....	.	....	....	....	......	....	.....
54	45	..	6	20,000	...	......	....	....	11	....	.....	11	.	....	...	11	......	....	11
55	....	..	....	......	...	......	....	....	....	12–6	.....	10·8	..	....	....	....	12–6	...	10·8
56	....	..	....	......	....	......	....	....	....	....	......	11	..	....	....	....	......	....	11
57	35	..	5	9,000	3,000	1,800	....	....	10	....	......	10	..	....	....	10	......	....	10
58	...	..	...	20,000	2,000	......	....	....	6	1.92	......	6	6	....	....	6	1.20	....	6
59	....	..	....	......	....	......	....	....	6	....	......	6	..	....	....	....	......	....	.....
60	....	..	....	......	....	......	35	....	....	1.50	......	....	..	35	....	....	3.00	....	.....
61	61	..	6 5	14,000	250	......	24	....	7·2	2.50	1.60	7·2	.	24	....	7·2 12 with disc. 5-25 p.c. according to amount consumed	2.50	1.60	7·2 12 with disc. 5-25 p c. according to amount consumed
62	63	..	....	18,832	6,224	.....	....	....	....	9.00	......	12	..	....	....		9 00	9.00	
63	....	..	...	22,000	500	500	....	....	....	....	......	6–11	..	....	....	....	.....	...	6–11
64	10 F	.	....	......	...	......	...	....	...	....	......	....	..	...	....	....	......	....	.....
65	5 48 10 F	..	6 6 6 10	60,279	7,000	1,600	64 to 80	....	....	....		....	10	....	....	....	......	....	.....
66	....	..	....	34,028	....	......	....	....	....	....	......	8	..	...	....	....	......	....	.....
67	....	..	....	......	....	......	....	....	....	....	......	....	..	....	....	....	......	....	.....
68	365 30 F	.	6 7–10	315,297	....	28,125	All metered, same as Public Lighting					....	..	....	....	...	......	....	....

F—Flaming arcs.

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL GENERATING STATIONS.

POWER-DATA AND PRICES.

No.	Motors			Price per K.W.H. in Cents	Irons		Heating Devices		Price per K.W.H. for power other than Motors in Cents	K.W. Load				K.W.H. Generated
										Maximum		Average		
	Number	Total H.P.	Price Flat Rate Dollars		Number	Total K.W.	Number	Total K.W.		Summer	Winter	Summer	Winter	
1	......	......	......	......	......	......	......	......	......	......	......	......	......	......
2	......	......	......	......	......	......	......	......	......	......	......	......	......	......
3	......	......	......	......	......	......	......	......	......	50	60	......	......	......
4	......	......	......	......	......	......	......	......	......	......	......	......	......	......
5	......	......	......	......	......	......	......	......	......	10	20	8	15	......
6	......	......	......	......	......	......	......	......	......	50	35	......	......	......
7	......	......	......	......	......	......	......	......	......	17	20	12	16	......
8	7	88	1 h.p. 50 2 h.p. 40 10 h.p. 35 25 h.p. 30 50 h.p. 25	......	20	6	......	......	8	125	125	......	......	......
9	......	......	......	......	......	......	......	......	......	......	......	......	......	......
10	......	......	......	......	2	1	......	......	......	35	......	......	42	......
11	......	......	......	......	......	......	......	......	......	......	......	......	......	......
12	......	......	......	......	4	1·6	......	......	10	28	33	......	......	......
13	3	33	......	......	1	·06	......	......	......	200	200	......	......	......
14	......	......	......	......	......	......	......	......	......	......	......	......	......	......
15	......	......	......	......	......	......	......	......	......	40	60	......	......	......
16	1	6	......	......	......	......	......	......	......	25	50	10	13	59,743
17	......	......	......	......	......	......	......	......	......	......	......	......	......	......
18	......	......	......	......	......	......	......	......	......	60	80	40	55	......
19	......	......	......	......	......	......	......	......	......	85	90	85	90	......
20	......	......	......	......	......	......	......	......	......	......	......	......	......	......
21	1	80	......	......	......	......	......	......	......	175	200	150	200	......
22	......	......	......	......	......	......	......	......	......	......	......	......	......	......
23	2	·6	......	10	......	......	......	......	10	100	150	70	100	......
24	......	......	......	......	......	......	......	......	......	450	600	300	400	......
25	6	50	......	......	......	......	......	......	......	......	......	50	110	......

26	......	......	.....	....	......	......	.....	......	....	......	50	30	35	45
27	31	189	......	....	20	9·2	15	7·6	1st 50—9 next 100—7 next 850—5 over 1000—4½ with 20 p.c. disc.	......	......	......	......	....
28	......	......	.....	....	......	......	......	......	....	40	80	35	75	....
29	19	161	......	....	100	60	3	5	....	300	450	300	300	....
30	15	275	......	3-4 to 2 plus minimum monthly charge	20	10	15	6	6 for all but motors	......	......	......	......	....
31	......	......	......	....	......	......	.....	......	....	50	50	......	......	....
32	1	5	......	....	......	.....	......	......	....	......	......	......	.....	....
33	......	......	24	....	......	......	......	......	....	......	.....	......	......	....
34	......	75	......	....	......	.....	.....	......	....	.....	......	......	......	....
35	2	180	30	....	......	.....	......	......	....	......	217	......	......	....
36	6	185	20 to 40	1·5 plus $18 h.p.	22	13	5	3	4-5	......	......	......	......	....
37	......	......	......	....	.....	......	......	......	....	180	225	180	225	....
38	......	......	......	....	......	......	......	......	....	......	......	......	......	....
39	....	......	......	....	......	......	.....	......	....	......	......	......	......	....
40	5	35	......	6 to 12	12	......	35	......	12	130	180	100	110	....
41	100	250	......	....	......	.....	......	......	....	......	250	.....	......	....
42	31	1,375	50 to 10	5	100	50	20	5	5	1,300	1,470	950	1,175	....
43	31	137	.....	8 with 40% disc. when excess of 1000	......	......	......	......	8	150	270	60	50	....
44	.....	......	......	....	......	......	......	.....	....	300	420	......	.....	....
45	24	101	......	1¼ to 2 plus $18 h.p.	125	.....	......	.....	9	......	......	......	......	....
46	44	125	20	....	135	.....	......	......	....	......	......	......	.....	....
47	24	225	50 to 60	3	......	......	......	......	....	200	350	.....	......	....
48	25	462	......	....	50	25	6	5	....	240	300	150	175	....
49	105	185	.....	2 to 5	200	74	130	9	2 to 5	......	324	.....	138	....
50	156	2,500	12 to 18	....	25	5	7	25	....	1,150	1,550	905	1,000	....
51	218	155	35 to 60	5 to 10	55	25	10	5	5 to 10	180	350	135	275	....
52	.....	......	......	2 plus $1.50 h.p.	546	240	......	120	4 to 9	300	425	175	390	....
53	......	......	......	....	......	......	......	......	....	......	......	.....	......	....

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL GENERATING STATIONS.

POWER—DATA AND PRICES.

No.	Motors			Price per K.W.H. in Cents	Irons		Heating Devices		Price per K.W.H. for power other than Motors in Cents	K.W. Load				K.W.H. Generated
										Maximum		Average		
	Number	Total H.P.	Price Flat Rate Dollars		Number	Total K.W.	Number	Total K.W.		Summer	Winter	Summer	Winter	
54	......	......	......	....	......	......	......	......	......	250	600	......	......	....
55	5	470	27	11 to 6	......	......	......	......	11 to 6	......	500	......	270	....
56	......	......	......	....	......	......	......	......	8	400	900	......	......	....
57	60	100	......	....	100	45	......	......	....	230	450	......	......	....
58	34	831	25	....	......	......	......	......	....	1,400	1,400	......	......	....
59	115	1,560	......	1	500	250	......	......	1	840	1,420	820	530	....
60	......	......	20	....	......	......	......	......	....	450	1,000	450	1,000	....
61	......	......	......	....	......	......	......	......	....	2,000	2,000	......	......	....
62	55	2,481	......	3¼ to 9	......	......	......	43·5	5	601	702	400	550	3,193,756
63	40	250	......	....	......	......	......	......	....	325	600	200	275	....
64	108	850	......	....	1,000	70	250	25	....	1,250	1,650	......	......	3,033,150
65	186	1,112	......	11 to 25	5	5	......	......	7 to 5	......	......	......	......	7,412,065
66	......	1,153	......	....	......	......	......	......	....	1,600	2,000	1,000	1,200	520,100
67	......	......	......	....	......	......	......	......	....	......	......	......	......	....
68	1,524	19,406	......	2 to 7	12,000	600	......	......	2 to 7	4,400	9,600	2,745	4,653	59,542,740

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL CENTRAL STATIONS.

FINANCIAL RETURNS

No.	REVENUE IN DOLLARS											EXPENDITURE IN DOLLARS				
	Public Arc Lighting	Public Incandescent Lighting	Public Power	Commerc'l Arc Lighting	Commerc'l Incandescent Lighting	Commerc'l Power	Signs	Wiring and Supplies	Meter Rents	Miscellaneous	Total	Fixed Charges	Depreciation	Maintenance and Repairs	Operating Costs	Total
1	....	......	....	......	......	......	....	......	....	......	......	......	......	......	......	......
2	....	......	....	......	......	......	....	......	....	......	......	......	......	......	......	......
3	....	......	....	......	......	......	....	......	....	......	......	......	......	303	5,725	3,118
4	....	......	....	......	......	......	....	......	....	......	......	......	......	......	......	......
5	....	......	....	......	......	......	....	......	....	......	......	......	......	......	......	......
6	....	......	....	......	......	......	....	......	....	......	4,000	......	......	......	......	......
7	....	55	....	......	1,363	......	....	......	....	350	1,768	68	......	460	540	1,068
8	....	......	....	......	......	......	....	......	....	......	5,200	......	......	......	......	......
9	500	70	....	......	......	......	....	......	15	......	......	......	......	......	......	......
10	....	480	....	......	2,520	......	....	......	....	......	3,000	......	......	......	......	......
11			2,697			......	....	387	....	......	3,084	36	2,861		......	3,697
12	637	......	....	......	2,600	......	....	1,345	....	145	3,372	......	......	......	......	......
13	575	......	....	......	......	......	....	800	....	......	......	......	......	......	......	......
14	....	......	....	......	......	......	....	......	....	......	2,500	......	......	......	......	......
15	1,260	6,683	....	......	......	......	....	1,858	193	410	10,405	2,006	1,000	......	2,008	......
16	....	500	....	......	1,500	......	....	75	....	400	2,475	900	750	100	900	3,150
17	....	1,465	....	......	6,699	......	....	746	....	4,092	13,004	54	1,560	1,088	6,280	12,877
18	1,927	5,250	....	......	......	......	....	980	....	......	8,157	203	......	......	6,189	......
19	300	420	....	......	......	......	....	......	....	......	......	......	......	......	......	......
20	....	......	....	......	......	......	....	......	....	......	4,500	......	1,000	1,000	1,500	3,700
21	....	......	....	......	6,000	1,500	....	......	....	......	......	......	......	200	2,300	7,500
22	....	775	....	......	3,175	......	....	......	....	......	3,950	......	......	......	......	......
23	1,500	300	....	......	......	......	....	......	....	......	......	......	......	......	......	......
24	....	2,300	....	......	......	......	....	......	....	......	......	......	......	......	......	......
25	....	......	....	......	......	......	....	......	....	......	......	......	......	......	......	......
26	....	125	....	......	......	......	....	714	450	......	1,279	......	......	565	1,043	......

27	....	....	....	....	6,040	3,500	....	1,380	....	231	11,156	116	625	383	5,158	9,267
28	....	575	....	....	4,200	....	....	....	....	....	4,775	....	....	200	1,500	3,075
29	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
30	....	....	....	....	....	....	....	....	....	....	9,000	....	....	....	....	....
31	....	1,125	....	....	6,975	....	....	750	240	....	9,090	....	....	2,901	2,218	9,090
32	....	....	....	....	....	....	....	....	....	....	4,110	....	100	26	1,100	2,700
33	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
34	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
35	....	....	....	....	....	....	....	....	....	....	25,111	....	....	....	....	7,407
36	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
37	2,145	....	....	133	9,635	....	....	527	....	....	12,441	....	1,500	314	1,995	5,565
38	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
39	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
40	....	2,400	....	10,800		250	....	....	....	....	13,450	2,679	....	962	7,141	11,383
41	....	....	....	....	....	....	....	....	....	....	31,818	....	....	....	....	25,586
42	2,730	40,802	1,600	720		15,000	300	....	1,600	250	63,002	22,530	....	4,924	12,275	39,730
43	....	....	....	30,634		2,871	....	....	1,602	193	35,301	4,556	....	....	17,854	27,738
44	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
45	2,346	15,562	....	....	1,357	1,154	....	101	189	171	20,883	5,639	....	13,047		18,687
46	4,450	19,500	....	....	....	11,000	....	900	....	....	35,850	....	....	....	10,000	25,850
47	5,400	....	....	18,014		4,303	....	....	....	398	28,117	3,019	2,341	974	13,605	19,939
48	845	1,200	....	19,456		9,514	....	....	....	60	31,065	6,651	....	3,374	11,638	23,352
49	....	....	....	27,753			....	175	....	....	27,928	2,454	....	1,285	....	17,060
50	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
51	....	....	....	....	....	....	....	....	....	....	31,080	2,540	....	8,027	10,428	20,995
52	5,740	1,206	....	25,215			....	....	....	1,821	....	4,675	5,133	1,705	5,294	....
53	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL CENTRAL STATIONS.

FINANCIAL RETURNS

No.	REVENUE IN DOLLARS											EXPENDITURE IN DOLLARS				
	Public Arc Lighting	Public Incandescent Lighting	Public Power	Commerc'l Arc Lighting	Commerc'l Incandescent Lighting	Commerc'l Power	Signs	Wiring and Supplies	Meter Rents	Miscellaneous	Total	Fixed Charges	Depreciation	Maintenance and Repairs	Operating Costs	Total
54	5,500	1,000	....	......	2,500	......	....	5,000	2,300	3,037	41,837	3,452	5,000	1,555	18,928	......
55	5,360	.....	....	.....	......	......	....	......	....	.....	......	......	......	......	......	......
56	....	......	....	.....	......	......	....	......	....	......	......	......	......	......	......	......
57	6,057	663	....	741	25,056	5,359	....	489	1,558	54	39,980	6,547	5,000	2,816	11,075	28,243
58	...	......	....	.....	......	......	....	......	....	......	......	......	......	......	......	75,745
59	....	......	....	......	......	......	....	......	....	......	92,000	......	......	......	......	......
60	....	......	....	......	......	......	....	......	..	......	......	......	......	......	......	......
61	....	.....	....	......	......	......	....	......	....	.....	......	......	......	......	......	......
62	....	......	....	.....	......	......	...	.....	....	......	......	......	......	......	......	......
63	...	......	....	......	......	....	....	......	....	......	......	......	......	.....	......	......
64	....	......	....	.....	......	.....	....	......	....	.....	......	......	......	9,431	120,541	......
65	....	......	....	.....	......	......	....	......	....	......	.....	......	......	.....	......	......
66	...	......	....	......	.....	......	....	......	....	......	......	.....	......	......	......	......
67	...	.....	....	.....	......	......	....	......	....	......	......	......	......	......	.....	......
68	...	......	....	.....	......	......	..	.....	....	......	.....	......	....	......	......	......

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL CENTRAL STATIONS.

FINANCIAL RETURNS

No.	Fuel Costs		Character of Fuel	Gross Revenue		Operating Expenses		Revenue Per Capita	Incandescent Lamps Per Capita (reduced to 16 C.P. Equivalent) Carbon	Incandescent Lamps Per Capita (reduced to 25 W. Equivalent) Metallic Filament	Cost to Town of Street Lighting Per Capita
	Total	Per Ton		Per K.W. Station Capacity	Per $100 Invested	Per Cent. Gross Revenue	Per $100 Invested				
1	......	......	......	......	......	......	......	......	......	......	......
2	......	......	......	......	......	......	......	......	......	......	......
3	......	......	......	......	......	......	......	......	......	......	......
4	......	......	......	......	......	......	......	......	......	......	......
5	......	......	......	......	......	......	......	......	1·08	·067	......
6	......	......	Mill Refuse Soft Coal	53·5	......	......	......	·5	1·87	·25	......
7	......	......	......	59	17·68	60·4	10·68	1·96	·39	·055	·061
8	......	......	......	16	17·2	......	......	5·8	1·1	·55	......
9	......	......	......	......	......	......	......	......	·028	......	·63
10	......	......	......	40	......	......	......	3·33	·1	......	53
11	1,287	......	Coal, Slack	88·1	10·3	120	12·32	3·08	·4	·3	......
12	939	......	Wood, Slack, Coal	75	......	......	......	2·81	......	·25	·53
13	......	......	......	......	......	......	......	......	1	......	·48
14	......	5	Pea Coal	......	17·8	......	......	1·92	......	......	......
15	2,107	......	Coal	49·6	36·7	......	......	6·95	......	......	5.29
16	......	......	Sawdust Mill Refuse	19·6	......	122	......	......	......	......	......
17	3,194	......	Wood and Lignite	163	......	98·9	......	......	......	......	......
18	3,368	......	......	102	......	......	......	5·34	·13	·167	4·77
19	......	......	......	......	......	......	......	......	·93	......	·45
20	......	......	......	22·5	42	82·3	34·4	2·5	3·88	·278	......
21	......	......	......	......	......	......	......	......	·95	·11	......
22	1,400	......	Bituminous Coal	55·5	......	......	......	1·97	·6	......	·38
23	......	......	Steam Coal Bituminous	......	......	......	......	......	1·5	......	·9
24	2,000	......	......	......	......	......	......	......	1·3	......	1·15

25	....	.....	....	....	....	....	....	....	1·1	·18	....
26	1,000	.....	....	17·05	6·95	....	....	....	....	....	....
27	....	.....	....	38·5	55·7	83·5	46·3	3·7	2	·05	....
28	....	.....	....	63·6	....	64·2	....	1·59	·53	·033	·19
29	....	.....	....	....	....	....	....	....	1·71	....	....
30	....	.....	....	18·0	....	....	....	2·85	·43	·14	....
31	....	.....	....	40·4	26·2	100	26·2	2·6	·86	....	·32
32	....	.....	....	54·8	20·55	65·8	13·5	1·17	·71	·012	....
33	....	.....	....	....	....	....	....	....	·77	·01	....
34	....	.....	....	....	....	....	....	....	·5	....	....
35	....	.....	....	10·45	....	29·7	....	6·27	....	....	....
36	....	.....	....	....	....	....	....	....	1·07	·42	....
37	....	.....	....	41·4	41·4	....	....	3·11	·05	....	·53
38	....	.....	⅔ Lump Soft Coal Pine Slab & Edges	....	....	....	....	....	....	....	......
39	....	.....	....	....	....	....	....	....	....	....	....
40	....	.....	....	41·4	20·7	85·	17·5	2·69	....	....	·48
41	....	.....	....	33·7	11·5	63·	7·22	10·42	1·1	....	7·25
42	9,846	.....	Jack Pine Cordwood	105·5	30·2	78·5	23·6	5·04	1·14	....	....
43	....	.....	....	70·5	25·4	80·1	21·2	5·3	1·08	....	....
44	....	.....	....	....	....	....	....	....	....	....	....
45	7,504	.....	⅔ Lump Soft Coal	46·4	26·4	90·5	23·2	2·98	....	....	2·56
46	....	.....	....	44·8	13·6	72·1	9·8	4·48	1	·062	3
47	7,139	.....	Slack, Coal	70·4	35·2	70·9	25·	3·12	1·11	....	·6
48	898	.....	....	25·9	36·5	77·4	27·4	3·45	·89	....	·228
49	4,596	.....	Natural Gas	42·9	11·9	60·9	7·3	2·79	2	·2	....
50	....	.....	....	....	....	....	....	....	1	....	....
51	3,195	.....	....	69·	22	67·8	13·7	2·82	1·13	·054	....
52	....	3·61	Lump Soft Coal	....	....	....	....	....	....	....	·578
53	....	.....	....	....	....	....	....	....	....	....	....
54	7,928	.....	Coal	69·7	69·8	....	....	3·48	1·67	....	·54

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL CENTRAL STATIONS.

FINANCIAL RETURNS

No.	Fuel Costs		Character of Fuel	Gross Revenue		Operating Expenses		Revenue Per Capita	Incandescent Lamps Per Capita (reduced to 16 C.P. Equivalent) Carbon	Incandescent Lamps Per Capita (reduced to 25 W. Equivalent) Metallic Filament	Cost to Town of Street Lighting Per Capita
	Total	Per Ton		Per K.W Station Capacity	Per $100 Invested	Per Cent. Gross Revenue	Per $100 Invested				
55	....	1·80	Bitumi..ous Lignite	....	....	....	....	....	....	....	·38
56	....	......	....	....	....	....	....	....	....	....	....
57	6,549	3·93	¾ Lump Gas Coal	88·8	58·	70·6	40·9	....	....	....	....
58	....	......	....	....	....	....	....	....	1·25	·125	....
59	....	......	....	65·6	36·8	....	....	5·1	....	....	....
60	....	......	....	....	....	....	....	....	....	....	....
61	....	......	....	....	....	....	....	....	....	·27	....
62	....	2·28	Coal Run of Mine	....	....	....	....	....	·82	....	....
63	....	......	....	....	....	....	....	....	·88	88·02	....
64	73,760	......	Lignite, Coal	....	....	....	....	....	....	....	....
65	....	2·75	Slack	....	....	....	....	....	1·2	·14	....
66	....	......	....	....	....	....	....	....	....	....	....
67	....	......	....	....	....	....	....	....	....	....	....
68	180,000	......	Bituminous Washed Nut & Pea	....	....	....	....	....	1·8	....	....

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL GENERATING STATIONS.

RAILWAY LOAD AND ANALYSIS OF OPERATING COSTS.

No.	RAILWAY LOAD				MOTORS		ANALYSIS OF OPERATING COST DOLLARS								
	Maximum K.W.	Average K.W.	Hours per day connected	Generator capacity K.W.	Maximum num. run. at one time	Normal H.P.	Fuel	Feed and cooling water	Oil waste and sundries	Rent rates and taxes	Manage-ment	Labor	Purchased power if any	Miscel-laneous	Total
1	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
2	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
3	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
4	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
5	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
6	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
7	......	......	......	......	......	......	......	......	45	17	70	400	....	8	540
8	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
9	......	......	......	......	......	......	......	......	......	......	1,200	200	......	......	......
10	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
11	......	......	......	......	......	......	1,287	......	80	20	1,000	25	......	1,285	3,697
12	......	......	......	......	......	......	939	......	49	59	......	770	......	......	......
13	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
14	......	......	......	......	......	......	......	120	140	......	......	......	......	......	......
15	......	......	......	......	......	......	2,107	......	2,660	405	1,500	2,008	......	......	......
16	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
17	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
18	......	......	......	......	......	......	3,368	......	202	......	2,526	44	......	47	6,189
19	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
20	......	......	......	......	......	......	......	......	50	50	375	1,000	......	....	1,475
21	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
22	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
23	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
24	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
25	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
26	......	......	......	......	......	......	1,000	......	50	130	175	1,800	......	......	......

27	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
28	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
29	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
30	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
31	......	......	......	......	......	......	......	......	103	311	300	1,500	......	2,901	9,090
32	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
33	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
34	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
35	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
36	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
37	......	......	......	......	......	......	......	......	50	355	1,380	1,380	......	210	1,995
38	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
39	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
40	......	......	......	......	......	......	2,618	......	212	......	900	2,411	......	1,962	8,103
41	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
42	......	......	......	......	......	......	......	......	275	......	3,000	9,000	......	......	12,275
43	......	......	......	......	......	......	9,846	......	429	......	6,750	337	......	494	17,854
44	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
45	......	......	......	......	......	......	7,504	191	270	......	3,525	3,525	......	1,532	13,047
46	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
47	......	......	......	......	......	......	7,139	......	372	......	1,853	2,869	......	1,370	13,605
48	......	......	......	......	......	......	898	......	146	1,337	2,733	703	5,527	291	11,638
49	450	200	18	1,100	19	50	4,590	......	789	469	1,789	3,710	......	5,705	17,060
50	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
51	......	......	......	......	......	......	3,195	......	112	1,873	4,096	4,096	......	1,149	10,428
52	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
53	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
54	......	......	......	......	......	......	7,928	350	175	2,152	3,000	4,836	......	486	18,928
55	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
56	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
57	......	......	......	......	......	......	6,549	......	637	296	1,225	2,366	......	......	11,075
58	......	......	......	800	......	......	......	......	......	......	......	......	......	......	......

TABULATED STATEMENTS FROM RETURNS OF ELECTRICAL GENERATING STATIONS.

RAILWAY LOAD AND ANAYLSIS OF OPERATING COSTS.

No.	RAILWAY LOAD				MOTORS		ANALYSIS OF OPERATING COST DOLLARS								
	Maximum K. W.	Average K.W.	Hours per day connected	Generator capacity K.W.	Maximum num. run. at one time	Normal H.P.	Fuel	Feed and cooling water	Oil waste and sundries	Rent rates and taxes	Manage-ment	Labor	Purchased power if any	Miscel-laneous	Total
59	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
60	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
61	1,320	......	24	1,450	130	40	......	......	.....	......	......	......	......	......	......
62	488	400	18	1,300	36	40	....	.....	......	......	......	......	......	......	......
63	650	250	20	600	......	30	......	......	......	......	......	......	......	......	......
64	1,017	......	19	1,400	84	40	73,760	......	7,712	......	.....	......	......	.....	......
65	....	......	......	......	......	......	......	......	......	......	......	......	.....	......	......
66	1,300	800	18	1,600	84	35	......	......	......	......	......	......	......	......	......
67	......	......	......	.....	......	......	.....	......	......	......	......	......	......	.....	......
68	7.250	2,745	24	10,000	540	Average 45·2	.....	......	......	.....	......	....	......	......	......

GENERAL BUSINESS.

The President: Under our revised constitution there is only one standing committee and that is the Managing Committee. The others are called special committees, and they are named at the annual meeting to cover any special subjects that you wish to have dealt with during the year. It is also permissible for the Managing Committee to itself appoint committees if it is deemed necessary. If there is any subject which you think ought to be investigated now is the time to make your wishes known.

Mr. Black: I would like to make a sort of blanket motion. I think it would be well to leave all unfinished business, the selecting of the next place of meeting, and naming of the committees, to the incoming Executive Committee. I would move that, and also that the Secretary be empowered to write letters of thanks to all those who have contributed to the success and entertainment of this Convention.

Mr. Pack: I second the motion.

The Secretary: Does that include the invitation to the British Institution of Electrical Engineers?

Mr. Black: My motion is intended to leave it to the good judgment of the incoming Managing Committee and their able Secretary to do what is proper in that regard.

The President: This brings to a close perhaps the best convention that was ever held by this society, both as regards papers, attendance, and the general interest shown in the proceedings. I think it has not been excelled. I would like you to take this as an indication of the progress which we may expect under the new conditions of affiliation with the National Electric Light Association. I think it has been the means of instilling a new spirit into our institution, and that is what I expected of it. I thank you for your attendance.

This meeting stands adjourned till next year at a place to be decided upon by the Managing Committee.

CONSTITUTION OF THE CANADIAN ELECTRICAL ASSOCIATION

As Amended January 20th, 1911.

(In Affiliation with the National Electric Light Association)

CONSTITUTION.

Article I.

This organization shall be known as the "Canadian Electrical Association," and is in affiliation with the "National Electric Light Association," whereby members of either Association residing in Canada shall be members of both Associations.

Article II

Headquarters.—The permanent office of the Association shall be in Toronto.

Article III.

Objects.—The objects of the Association shall be:

(a) To advance the professional interests and knowledge of the members in the various branches of applied electricity by holding meetings for the reading and discussion of papers and general interchange of opinions.

(b) To foster friendly intercourse between the members.

(c))To promote the commercial interests of members engaged in the sale of electric light, heat and power.

Article IV.

Membership.—(a) Members shall be divided into six classes: Active Member Companies (Class A); Members (Class B); Invited Members (Class C); Associate Member Companies (Class D); Associate Members (Class E); and Honorary Members.

(b) Class A members shall be private corporations or individuals, located in Canada, engaged in the business of producing and supplying electricity for light, heat or power for commercial or public use. They shall be entitled, through their regularly accredited delegates, to attend all meetings of this Association, to vote and to hold office.

No syndicate, holding company, or other corporation or association in Canada controlling or managing electric light companies, and no hydro-electric or power supply company in Canada supplying current to an electric light company or companies shall be eligible to membership as a Class A member unless all of its constituent electric light companies in Canada, or companies in Canada purchasing electricity from it, are Class A member companies of the Canadian Electrical Association in good standing. But if all these constituent electric light companies of any syndicate, holding company or other corporation or

association in Canada, controlling or managing electric light companies, or if all the electric light companies purchasing current from a hydro-electric company or other power supply company in Canada are Class A members in good standing in the Canadian Electrical Association, said syndicates, holding companies or other corporations or associations and said hydro-electric companies or other companies supplying power, are eligible to Class A membership in this Association, and may become Class A member companies.

(c) Class B members shall be officers or employees of Class A member companies of the C.E.A.; or Class A member companies of the N.E.L.A. located outside of Canada, provided said officers or employees are located in Canada; and they shall be elected and continued only from year to year with the written consent of the Class A member company with which they are connected. They shall have all the privileges of Class A members except the right to vote and to attend the executive sessions of this Association, but shall be allowed to attend such executive sessions upon obtaining the written consent of the Class A member company vouching for their membership.

(d) Class C members shall be instructors, teachers, and practitioners of engineering and related sciences and of other professions, and others who are in sympathy with and approve of the objects of this Association. They may become members only upon the annual invitation of the Managing Committee of this Association. They shall have all the privileges of Class A members except the right to vote, to hold elective office and to attend the executive sessions.

(e) Class D members shall be electricians, electrical or mechanical engineers, manufacturers and publishers — corporations or individuals who are located in Canada, and who are directly or indirectly interested in advancing the use of electricity. They shall have all the privileges of Class A members except the right to vote, to hold office and to attend executive sessions.

(f) Class E members shall be officers or employees of associate Member Companies of the C.E.A.; or associate member companies of the N.E.L.A. located outside of Canada, provided said officers or employees are located in Canada, and they shall be elected and continued only from year to year with the written consent of the Class D member company with which they are connected. They shall have the same privileges as Class D members.

(g) Honorary members shall be gentlemen whose scientific or practical knowledge in matters relating to the electrical industry and whose efforts and interests on behalf of said industry shall commend them to this Association. They shall be elected upon unanimous recommendation of the Managing Committee, approved by a two-thirds vote of this Association. They shall have all the privileges of Class A members except the right to vote, to hold elective office, and to attend the executive sessions.

(h) Every application for active or associate membership shall be made in writing to the Secretary, and must contain a signed agreement by the applicant to comply with the requirements of the Constitution, if elected. All applications shall be referred to the Managing Committee, and if accepted by a majority vote, the applicant shall be enrolled as a member and the application placed on file. If any applicant fails of election, no notice of his application shall be made in the minutes of the meeting; but the application, endorsed ''not accepted,'' shall be placed on file.

(i) All members of the National Electric Light Assosciation (hereinafter called the N.E.L.A.) residing in Canada are hereby made members of this Association (hereinafter called the C.E.A.) and all members of this Association shall be members of the N.E.L.A. as well. Applicants for membership shall fill and sign a joint application form. Members and Company Sections of the N.E.L.A. in Canada shall be members and Company Sections of the C.E.A. as well.

(j) Resignations must be in writing, addressed to the Secretary, and may be accepted if the member is not in arrears for dues.

(k) In case of a corporation, the membership shall stand in the name of the Company, and such Company shall have the right to be represented at any meeting of this Association by any one of its officers or directors, or by its regularly employed manager or superintendent. Each such Company member shall have one vote only on the election of officers and Managing Committee, and on all questions coming before exclusive meetings of representatives of Class A members and Class B members which shall be designated as ''Executive Sessions.''

(l) Accredited representatives of Class A members and Class B members are alone eligible to office or to the Managing Committee.

Article V.

Dues.—(a) The dues charged for membership in this Association will cover membership in the N.E.L.A. as well. Dues must be paid to the Treasurer of the C.E.A. (except as hereinafter provided). The C.E.A. will be entitled to retain one-half of the fixed dues paid by its members except the receipts from Class A members based on their gross income, and from Class D members based on their enrolment of representatives at the N.E.L.A. Conventions. The balance shall be due and payable to the N.E.L.A. by the C.E.A. The said dues and the conditions of membership shall be as follows:

Section 1.—The annual dues of Member Companies (Class A) in cities and towns of less than 5,000 population, shall be ten dollars; in cities and towns of 5,000 and less than 10,000, shall be fifteen dollars; in cities and towns of 10,000 and less than 25,000, shall be twenty dollars; in cities and towns of 25,000 or more shall be twenty-five dollars plus one-hundredth of one per cent. of the gross receipts from electric sales of the company for the preceding calendar year, providing, however, the maximum amount of dues from any one Class A member shall not exceed $1,250.

No syndicate, holding company or other corporation or association controlling or managing electric light companies, and no hydro-electric company or power supply company supplying current to an electric light company or companies, shall be eligible to membership as a Class A member unless all of its constituent electric light companies or companies purchasing electricity from it are Class A members of the Association in good standing. But if all the constituent electric light companies of any syndicate, holding company or other corporation or association controlling or managing electric light companies, or if all the electric light companies purchasing current from a hydro-electric company or other power supply company, are Class A members in good standing in the Association, said syndicates, holding companies or other corporations or associations and said hydro-electric companies or other companies supplying power are eligible to Class A membership in the Association, and may become Class A members after being duly elected and upon payment of dues of fifty dollars per annum.

Section 2.—The annual dues for Class B members shall be five dollars, including membership in any one section, other than a Company Section, and two and one-half dollars additional for membership in each addidtional section of the N.E.L.A.

Section 3.—The annual dues of Class C members shall be five dollars.

Section 4.—The annual dues of Class D members shall be twenty dollars. Each Class D member, however, shall pay to the Treasurer of the N.E.L.A. five dollars for each representative or guest enrolled under its name at the annual convention of the N.E.L.A. (But this does not apply to the Conventions of the C.E.A.)

Section 5.—The annual dues of Class E members shall be five dollars, including membership in any one section of the N.E.L.A. other than a Company Section, and two and one-half dollars additional for membership in each additional section of the N.E.L.A.

Section 6.—All dues shall be payable to the Treasurer in advance and shall cover the calendar year. Any member in arrears for one year's dues shall be dropped from the rolls, and before being reinstated, shall pay all dues outstanding against said member.

Article VI.

Officers.—The officers shall be a President, a First Vice-President, a Second Vice-President, a Third Vice-President, a Secretary and a Treasurer, and their term of office shall be one year.

The President and Vice-Presidents shall be ex-officio members of the Managing Committee. The President shall be ex-officio a member of all other Committees of the C.E.A. He shall be ex-officio a member of the Executive Committee of the N.E.L.A. The offices of Secretary and Treasurer may be held by one person.

Article VII.

Managing Committee.—The Managing Committee shall be composed of fourteen members (representatives of Class A members, or

Class B members, seven of whom shall remain in office for one year and seven for two consecutive years, as provided in Art. 16.

Article VIII.

Duties of the President.—The President shall preside at all meetings of the Association, call meetings of the Managing Committee on the request or with the consent of three members of said Committee, and, when directed by the said Committee, shall call special general Executive Sessions, countersign all cheques for disbursements, and generally manage the affairs of the Association and promote its interests.

Article IX.

Duties of Vice-Presidents.—The First Vice-President, or in his absence the Second and Third Vice-Presidents, shall in the absence of the President perform his duties. All Vice-Presidents shall assist the President whenever he may ask for such assistance.

Article X.

Duties of the Secretary.—The Secretary shall attend all meetings of the Association and Managing Committee, keep a record of proceedings thereat, notify members of their election and of all meetings, and perform such other duties as the President or the Managing Committee shall direct. He shall report at every Annual Convention on the state of the membership of the Association, and other matters of general interest to the members.

Article XI.

Duties of the Treasurer.—The Treasurer shall keep correct accounts of all cash receipts and disbursements, assets and liabilities of the Association; deposit all the funds of the Association in a chartered bank approved by the Canaging Committee, and make no payments unless authorized by the Managing Committee; make all payments by cheques, countersigned by the President. He shall furnish bonds satisfactory to the Managing Committee of the C.E.A. and to the Executive Committee of the N.E.L.A. He shall submit at every Annual Convontion a financial statement for the preceding calendar year.

Article XII.

Duties of the Managing Committee.—The Managing Committee shall be the governing body of the Association; they shall manage the funds of the Association; pass upon all applications for membership and the eligibility of applicants, subject to the Constitution.

Article XIII.

Meetings.—(a) The Association shall hold a Convention annually at a place to be selected, as provided by Article 14, and at such time as the Managing Committee for the year in which such Convention is held may decide, but not earlier than the 1st of June. Special general meetings, Executive Sessions, as meetings of representatives of Class A members shall be designated, and meetings of the Managing Committee, may be held as provided by Article 8.

(b) One or more Executive Sessions shall be held during the progress of every Annual Convention for the purpose of electing Officers and the Managing Committee, and to consider all other matters affecting the management or interests of the Association.

(c) The President may issue invitation cards or badges to persons who are not members of the Association to attend the general sittings of any Annual Convention as guests of the Association.

Article XIV.

Place of Annual Convention.—At every Convention the Association, sitting as a whole, shall by a vote taken by ballot select the place of the next Annual Convention or by motion refer the decision to the Managing Committee elected or to be elected at said Convention.

Article XV.

Quorum.—Ten active members shall be a quorum for business at any meeting of the Association, all Class A members. At meetings of the Managing Committee the quorum shall be five.

Article XVI.

Election of Officers and Managing Committee.—(a) The officers and members of the Managing Committee shall be elected by ballot at an Executive Session during every Annual Convention, to hold office for the next ensuing year, commencing July first.

Not less than one month previous to each annual Convention the President, with the approval of the Managing Committee, shall appoint a Nominating Committee of five members from Class A and Class B, none of whom are officers of this Association, and the Nominating Committee so appointed shall at the Annual Convention submit a list of nominees for the different offices and for the Managing Committee, and if there is no contest for the offices, the Secretary shall be instructed to cast one ballot for the list of nominees presented by the Nominating Committee.

(b) The election shall take place in the following order: 1, The President; 2, The First Vice-President; 3, The Second Vice-President; 4, The Third Vice-President; 5, The Secretary; 6, The Treasurer; 7, The seven members of the Managing Committee who are to serve a further term of one year in accordance with Article 7; 8, the other seven members of the Managing Committee. All officers and members of the Managing Committee may be re-elected.

(c) The procedure shall be as follows:

1. The Chairman having read the report of the Nominating Committee, shall appoint two members to act as tellers, whose duty it shall be to collect the ballots, count the votes, and report the results to the Chairman. A nominee for any office cannot act as teller at the election for that office.

2. The Chairman shall call for nominations for the first office on the list in preceding Section (b), and allow two minutes, or more at his discretion, for making nominations, after which he shall declare the

nominations closed. Any member present may nominate any other Class A or Class B member for any office or for membership in the Managing Committee.

3. Every member shall deposit with the tellers a paper ballot bearing the name of the nominee or nominees for whom he desires to vote, and nothing else.

4. The tellers having reported the result of any vote, the Chairman shall declare elected the nominee or nominees receiving the greatest number of votes, unless in the case of officers, such number be less than a majority of the votes cast. If no nominee receives a majority of the votes cast, the nominee receiving the least number shall be retired from the contest and a new ballot shall be taken, repeating, if necessary, until a nominee shall have received a majority of the votes. This shall not apply to the election of the Managing Committee.

5. The procedure set forth in Sub-section 2, 3, and 4 of this Section shall be repeated for the different offices.

6. In electing the Managing Committee a ballot shall first be taken for the seven members who are to serve a further term. The result of this ballot having been announced, a second ballot shall be taken for the other seven members required. In both cases seven names must be written on each ballot paper, and the seven members receiving the greatest number of votes shall be elected.

7. If only one nomination is made for any office, or only seven nominations for each ballot of the Managing Committee, the Secretary shall deposit with the tellers a ballot which shall be deemed to represent the votes of all members present.

(d) At the request of three members present, made immediately after the result of any election has been announced, a recount of the votes shall be made by two new scrutineers appointed by the Chairman.

(e) At the close of the sitting at which elections are held, the President shall destroy all the ballots.

Article XVII.

Vacancies in Office.—Vacancies from any cause, in any office, including membership in the Managing Committee, occurring between Conventions, shall be filled, for the remainder of the current term, by the Managing Committee.

Article XVIII.

Committees.—(a) At any Annual Convention the members shall decide by resolution what Special Committees, if any, shall be appointed for the ensuing term.

(b) The members having decided by resolution what Special Committees are necessary, the appointment of the personnel of such Committees shall be made by the President-elect.

(c) All such Committees shall serve from the close of the Convention at which they are appointed until the close of the next following Convention.

(d) The member first named on any Special Committee shall be the Convenor thereof. At its first meeting every such Committee shall elect a Chairman, who shall thereafter be the Convenor.

(e) All Special Committees shall make a report at the Annual Convention following their election.

(f) The Managing Committee may appoint provincial committees in the various provinces of Canada for the purpose of increasing membership and assisting the Managing Committee in promoting the interests of the Association in their respective provinces. Said provincial committees shall each elect a Chairman and Secretary and notify the Secretary of the Association of such election. On the request of a majority of any such provincial committee, the Managing Committee may, at its discretion, authorize said Provincial Committee to hold a Provincial Convention under the auspices of this Association.

(g) The Managing Committee may appoint any other special committee deemed necessary.

Article XIX.

Auditors.—The President shall appoint two auditors to audit the accounts of the Treasurer at the close of the fiscal year and present a written report at the following Annual Convention.

Article XX.

Order of Business.—The following shall be the order of business at all Annual Conventions in general session. Time for general business, reading of papers, and discussions being allowed between or after the following orders, as may be arranged by the Managing Committee, and if not so arranged, at the discretion of the Chairman.

1. Reading and approval of the minutes of the last Annual Convention.
2. Reports of Secretary and financial statement of Treasurer.
3. Report of Auditors.
4. Other reports and communications.
5. Consideration of reports and communications.
6. Naming of Special Committees.
7. General business.
8. Selection of place for next Annual Convention.

At Executive sessions the order of business shall be:

1. Reading of minutes of last Executive Session.
2. Reports and communications.
3. Unfinished business.
4. New business.
5. Elections.

Article XXI.

Rules of Order.—(a) Voting. 1. Except where voting by ballot is prescribed herein, the Chairman shall take the sense of the meeting by voice, or by asking members to stand, but on demand of two Class A members the Secretary shall record the yeas and nays.

2. The Chairman shall not vote except in case of a tie, when he shall have the casting vote. Voting by proxy shall not be allowed.

(b) All motions must be seconded, and shall, except those of a purely routine character, be made in writing.

(c) No member, unless allowed by the Chairman, shall speak more than once on any question, motion or amendment, or at greater length than five minutes. The mover of a motion shall have the additional right to close the discussion.

(d) Any motion may be reconsidered immediately after its adoption, i.e., re-voted upon without discussion, on the demand of three active members present. The result of such re-vote shall be final.

(e) The Chairman shall decide all points of order. An appeal may be taken without debate against his ruling; a vote of two-thirds of the voting members present being required to reverse the ruling.

(f) Todd's Parliamentary Practice shall be the governing law of the Association in all cases not provided for in its own Constitution or By-laws.

Article XXII.

Amendments.—Amendments to this Constitution may be made at any general meeting, special general meeting called for the purpose, or Executive Session in the following manner:

1. Notice of proposed amendment in writing, after having been submitted to the meeting, shall be referred to a Committee of three members appointed by the Chairman.

2. Said Committee shall report to the meeting said amendment in its original form, or with such alterations in the form as said Committee shall deem advisable to recommend, without altering the sense or purport of the amendment.

3. The amendment may not be voted upon at the same sitting at which the said notice is submitted.

4. A two-thirds vote of voting members present shall be required to carry the amendment.

5. If the meeting is not held during an annual convention, the notice of proposed amendments must be sent to all Class A member companies with notice of such meeting at least ten days before the date set for it.

DEMAND RATES—Continued

Company	Type of Service	Base Rate	Prompt Payment Discount	Min. Bill	Remarks
The St. John Elec. Light Co., St. John, Ont.	Power				10 Hour Service H.P. — Rate per H.P. Yr. — H.P. — Rate per H.P. Yr. 1 — $75 00 — 8 — $55 00 2 — 73 00 — 9 — 52 00 3 — 70 00 — 10-15 — 50 00 4 — 66 00 — 16-20 — 45 00 5 — 62 00 — 21-40 — 40 00 6 — 60 00 — 41 and above — 35 00 7 — 57 50 8 Hour Service H.P. — Rate per H.P. Yr. — H.P. — Rate per H.P. Yr. 1 — 60 00 — 6 — 46 00 2 — 58 00 — 7 — 43 00 3 — 55 00 — 8-19 — 40 00 4 — 52 00 — 20-40 — 35 00 5 — 49 00 — 41 and above — 30 00 Stipulated damages for unfinished contract $4.00 per H.P. per month. Rates based on actual test for maximum demand. Motors not exceeding 5 H.P. take 75% power factor, not exceeding 10 H.P. take 80% power factor and exceeding 10 H.P. take 85% power factor.
City of St. Thomas, St. Thomas, Ont.	Power		10%	See fixed charges	DIFFERENTIAL BASE RATES H.P. of Peak Load — Fixed charges per H.P. Max. Demand — K.W.H. Meter Rates 1-3 — $15 00 — 3½ 4-10 — 14 40 — 2½ 11-25 — 13 80 — 3¼ 26-50 — 13 20 — 2 51-100 — 12 60 — 1 101 up — 12 00 — 1¼ Total monthly bill is fixed charges and metered charges. Class A—24 Hr. unrestricted use 100% of base rates " B—24 Hr. restricted use 90% of base rates " C—10 Hr. unrestricted use 90% of base rates " D—10 Hr. restricted use, 66⅔% of base rates 10% allowed on services at 13,200 V.A.C. Up to 10 H.P. motors 80% power factor Above 10 H.P. " 85% " " Maximum demand determined by test. Restricted Hours Oct. 15 to Oct. 31 — 5 30 p.m. to 6 30 p.m. Nov. 1 to Mar. 30 — 5 00 " " 6 30 " Dec. 1 to Jan. 15 — 4 30 " " 6 30 " Jan. 15 to Feb. 15 — 5 00 " " 6 30 " Feb. 15 to Mar. 1 — 5 30 " " 6 30 "
	Power (Flat Rates)	10%			BASE RATES H.P. of Peak Load — Flat rate per year based on Connected H.P. or Max. Demand 1-3 — $50 00 4-10 — 48 00 11-25 — 45 00 26-50 — 43 00 51-100 — 41 00 100 up — 40 00 Class A—24 Hr. unrestricted use 100% of Base Rate " B—24 " restricted " 90% " " " C—10 " unrestricted " 90% " " " D—10 " restricted " 66⅔% " " Restricted hours are same as under Demand Rates.
Toronto Electric Light Co., Toronto, Ont.	Commercial Lighting A.C. & D.C.	8c. & 3c. K.W.H. See remarks	10% 15% 20% See remarks	$1.00 per month per K.W. of Max. Dem.	8c. per K.W.H. for first 30 hours use of the Demand, 3c. per K.W.H. for all current used afterwards. Discounts 10% for prompt payment under 1 year contract 15% " " " 3 " " 20% " " " 5 " " First K.W. of installations to be considered, as unity maximum demand. 75% of excess to be taken as maximum demand.
	Power under 20 K.W. A.C. & D.C.	See remarks	10% 15% 20% See remarks	$1.00 per mo. per H.P. of Max. Dem.	For 1st 50 hrs. use of the maximum demand per month, 5c. per K.W.H., for 2nd 50 hrs. use of maximum demand, 1c. per K.W.H. For all current used over this amount ½c. per K.W.H. Discounts same as for Commercial Lighting.
	Power, over 20 K.W., A.C. & D.C.	See remarks	10% 15% 20% See remarks	$1.00 per mo. per H.P. of Max. Dem.	For 1st 50 hrs. use of maximum demand per month 4½c. per K.W.H. for 2nd 50 hrs. use of maximum demand 1c; per K.W.H., for all current used over this amount ½c. per K.W.H. Discount same as Commercial Lighting.
Toronto Hydro Electric System, Toronto, Ont.	Commercial Lighting A.C., 25 C. Single 115-230V.	8c. & 3c. See remarks	"	$1.00 net per K.W. of Max. Dem.	8c. per K.W.H. for 1st 30 hrs. monthly use of maximum demand all excess at 3c. per K.W.H.
	Power A.C.	See remarks	"	See Service Charges	Service charge of $1.35 per H.P. of maximum demand for 1st 10 H.P.; and $1.00 per H.P. of maximum demand for all excess, plus an energy charge of 1½c. per K.W.H. 1st 50 hrs. monthly use of maximum demand, 1c. per K.W.H. for next succeeding 50 hrs. monthly use of maximum demand, ½c. per K.W.H. for all excess.
	Power, D.C.	See remarks	"	See Service Charges	Same service charges as in A.C. Power, plus an energy charge of 2½c. per K.W.H. for 1st 50 hrs. use of maximum demand; 1½c. per K.W.H. for next 50 hrs. use of maximum demand and ¾c. per K.W.H. for all excess.
Western Canada Power Co., Vancouver, B.C.	Power	See remarks	Net	See Service Charges	Class A—1 to 100 H.P. Service charge of $1.00 per H.P. connected, plus energy charge of 1c. per K.W.H. Class B—100 to 500 H.P. Service charge $1.00 per H.P. maximum demand, plus energy charge of ½c. K.W.H. Class C—500 to 10,000 H.P.— Service charge $1.00 per H.P. maximum demand plus energy charge of ¼c. per K.W.H. Maximum demand for billing purposes obtained by 24 hour test at least once every six months. Tests made with hourly readings on wattmeters. Interruptions of one hour or more shall entitle a customer to a proportionate discount off of his service charges.
Walkerville Light & Power Co. Ltd., Walkerville, Ont.	Power	5c.	20% 50c. for reconnection if cut off for non-paym't of bills.	See fixed charges	LIMITED-HOURS SERVICE No Term—50c. net per H.P. maximum demand. (Fixed charge). 5c. per H.P. of maximum demand up to 50c. per H.P. per month will be allowed off bills for interruptions of service and in consideration of the fact that the hourly rebate being greater than the pro rata rebate the company has the privilege to interrupt service on Sundays or holidays, or for short periods to make repairs or changes, after notifying the customer on the day previous. UNLIMITED-HOUR SERVICE Two Year Term—2½c. gross for first 1,000 K.W.H., 2c. gross for excess plus $1.75 per month per H.P. of maximum demand. Interruption rebate of 5c. per H.P. of maximum demand up to $1.75 per H.P. per month. LIMITED HOUR SERVICE Two Year Term—2½c. gross for first 1,000 K.W. Hrs., 2c. gross for excess plus fixed charge of $1.00 per month per H.P. of maximum demand (fixed charge). Interruption rebate of 5c. per H.P. of maximum demand up to $1.00 per H.P. per month. Note—Restricted hours are Oct. 10 to Nov. 1 — 5 30 p.m. to 7 30 p.m. Nov. 1 to Nov. 15 — 5 00 " " 7 30 " Nov. 15 to Dec. 31 — 4 30 " " 7 30 " Jan. 1 to Jan. 20 — 5 00 " " 7 30 " Jan. 20 to Mar. 1 — 5 30 " " 7 30 " All Maximum Demands to be obtained by test.

DEMAND RATES Continued

Company	Type of Service	Base Rate	Prompt Paym'n't Discount	Min. Bill	Remarks
	Commercial Lighting	12 & 4c. K.W.H.	10%	26 hours use of connected load at 12c. per K.W.H.	26 hours use of lamp capacity at 12c. per K.W.H. Balance at 4c. per K.W.H.
	Combined Commercial & Residential Lighting	12&4c. K.W.H.	10%	26 Hrs. use of store load at 12c. K.W.H.	Total Charge is Floor area charge of 4c. per 100 sq. ft. for domestic floor, Plus 26 Hrs. per month use of store lamp capacity at 12c. per K.W.H., Plus all excess current at 4c. per K.W.H.
Montreal Light, Heat & Power Company, Montreal, Que.	Power for stipulated hours of Service Flat rate		"	"	Charge based on measured maximum demand 1–15 H.P. $50.00 per H.P. per annum 16–25 " 45.00 " " 26–50 " 40.00 " " 51–60 " 35.00 " " 61–70 " 34.00 " " 71–80 " 33.00 " " 81–90 " 32.00 " " 91–100 " 31.00 " " 101–150 " 30.00 " " 151–200 " 27.50 " " 200 and upwards Special Minimum Power Factor Up to 5 H.P. 75%, 5–10 H.P. 80%, 10 H.P. and over 85%, Meter rental Stipulated damage for broken contract $4.00 per month for H.P. equivalent
	Power				See same under Meter rates
Electrical Dept., City of Moose Jaw, Sask.	Power		10%	See fixed charges	BASE RATES FOR POWER H.P. or peak load — Fixed charge per installed H.P. per month or per H.P. of maximum demand — K.W.H. Rate 1–3 — $1.25 — $3\frac{1}{2}$c 4–10 — 1.20 — 3 11–25 — 1.15 — $2\frac{1}{2}$ 26–50 — 1.10 — 2 51–100 — 1.05 — $1\frac{1}{2}$ 101 up — 1.00 — $1\frac{1}{3}$ Total charge is fixed charge plus meter charge. Class A 24 hrs. unrestricted 100% of base rates. Class B 24 hrs. restricted 90% of base rates. Class C 10 hrs. unrestricted 90% of base rates Class D 10 hrs. unrestricted, 66.6% RESTRICTED HOURS Oct. 15th–Oct. 31, 5.30 p.m. to 6.30 p.m. Nov. 1st–Nov. 30th, 5.00 p.m. to 6.30 p.m. Dec. 1st–Jan. 15th, 4.30 p.m. to 6.30 p.m. Jan. 16th–Feb. 15, 5.00 p.m. to 6.30 p.m. Feb. 16th–Mar. 1, 5.30 p.m. to 6.30 p.m.
The Ottawa Electric Co., Ottawa, Ont.	Power Limited Service		10%		Max. Demand — Charge 1–5 H.P. — $20.00 6–25 " — 19.00 26–50 " — 18.00 51–100 " — 17.00 101 and up — 16.00 Applicable where time-switch is used and power never used between 4 and 10 p.m. from Oct. to March, inclusive. Maximum demand ascertained by test
Electric Dept. of Owen Sound	Power 1 to 5 H.P.	2c. K.W.H.	"	See fixed charges	Metered rates plus $1.00 per H.P. per month demand. Meter rental 25c. per month
	Power 5 H.P. and over.	$1\frac{1}{4}$c K.W.H.	"	See fixed charges	Metered rates plus $1.00 per H.P. per month demand Meter rent 25c. per month
City Gas & Electric Dept., Sherbrooke, Que.	Power	$15.00 H.P. Year			As a bonus to new industries. Based on Maximum Demand Load
Light and Heat Commission, Stratford, Ont.	Commercial Lighting	12c. and $4\frac{1}{2}$c. K.W.H.	10 & 20% See remarks	"	STORES AND THEATRES— 12c. K.W.H. for 1st hours daily use of connected load and $4\frac{1}{2}$c. K.W.H. for all excess SIGNS AND DISPLAY— Same as above or flat rate CHURCHES— Same as above but 20% instead of 10% for prompt payment. FACTORIES If use power, light given at power rates through transformers
	Power		10%	See fixed charges	BASE RATES H.P. of motors or Peak Load. — 1–3, 4–10, 11–25, 26–50, 51–100, 101 up Fixed charges per installed H.P. per year or Max. Dem. — $15.00 14.00 13.80 13.20 12.60 12.00 Plus meter rate per K.W.H. — $3\frac{1}{2}$c., 3c., $2\frac{1}{2}$c., 2c., $1\frac{1}{2}$c., $1\frac{1}{4}$c 24 Hr. unrestricted use 100% of base rate 24 " restricted " 90% & 10% " 10 " unrestricted " 90% " 10 " restricted " $66\frac{2}{3}$ & 10% " RESTRICTED HOURS— Oct. 15 to Oct. 31 — 5.30 to 6.30 p.m. Nov. 1 to Nov. 30 — 5.00 to 6.30 " Dec. 1 to Jan. 15 — 4.30 to 6.30 " Jan. 16 to Feb. 15 — 5.00 to 6.30 " Feb. 16 to Mar. 1 — 5.30 to 6.30 " Cost of test to arrive at Maximum Demand to be paid by consumer Minimum Power factor when operating at maximum load shall be 80% for motors up to 10 H.P. and 85% above 10 H.P.
	Power (Flat Rate)		10%		H.P. of motors on Peak Load — 1–3, 4–10, 11–25, 26–50, 51–100, 101 up Flat rate per H.P. year based on installed H.P. or Max. Dem. — $50.00 48.00 45.00 43.00 41.00 40.00 Max. Dem. to be determined by test at customer's expense
Tillsonburg Hydro Electric Comm., Tillsonburg, Ont.	Power		10%	"	$1.35 per H.P. Max. Dem. for 1st 10 H.P. and $1.00 per H.P. Max. Dem. in excess of 10 H.P. plus— 3c. K.W.H. for 1st 50 hrs. use Max. Dem. 2c. K.W.H. for 2nd 50 hrs. use of Max. Dem. 1c. K.W.H. for all additional consumption. 10% discount to those using power between 7 a.m. and 6 p.m. That is to 10 hr. users $33\frac{1}{3}$% discount to 10 hour users who shut off load during restricted hours. 50% discount to those using power exclusively during the night or from end of restricted period to 7 a.m. RESTRICTED HOURS Oct. 15 to Oct. 31 — 5.30 p.m. to 6.30 p.m. Nov. 1 to Nov. 30 — 5.00 p.m. to 6.30 p.m. Dec. 1 to Jan. 15 — 4.30 p.m. to 6.30 p.m. Jan. 16 to Feb. 15 — 5.00 p.m. to 6.30 p.m. Feb. 16 to Mar. 1 — 5.30 p.m. to 6.30 p.m.
	Power (Flat Rates)				$50 per H.P. yr. for 1st 10 H.P. of maximum demand. $40 per H.P. yr. for all power in excess of 10 H.P. demand.
	Commercial Lighting	12 & 5c. K.W.H. See remarks	10%	"	(a) STORES AND HOTELS 12c. K.W.H. for 1st hours daily use of installed capacity and 5c. K.W.H. for excess consumption (b) SIGNS AND DISPLAY LIGHTING Same as above or flat rate option (c) CHURCHES One half above rate (d) FACTORIES Same if not using power. If so, add required transformer capacity for connected lighting load to the motor load and charge at power rates

DEMAND RATES

Company	Type of Service	Base Rate	Prompt Payment Disc't	Min Bill	Remarks
Dundas, Municipal Corporation of Dundas, Ont.	Residence Lighting		10%	See Service Charges	Service charge of 1c per 100 sq. ft. of area lighted plus 3½c per K.W. for current. (Max. outside measurements taken multiply by number of floors. Reduce by 10% to allow for walls, etc. Basement and attic not included.)
	Commercial Lighting		10%		STORES AND THEATRES— 10c K.W. Hr. for 1st hours daily use installed capacity and 3½ K.W. Hrs. remainder. SIGNS AND DISPLAY LIGHTING Same as above or flat rate CHURCHES One-half of above FACTORIES Same as stores. Or if using power, necessary transformer capacity for lights may be added to power load and charged at power rates. HOTELS Same as stores. Peak load may be controlled.
	Power (metered)	See Remarks	10%	(See fixed Charges	BASE RATES H.P. of motors or Peak load: 1-3, 4-10, 11-25, 26-50, 51-100, 101 up Fixed charge per installed H.P. per year or max. demand: 15.00, 14.00, 13.80, 13.20, 12.60, 12.00 Meter rate per K.W.H.: 3½c, 3c, 2½c, 2c, 1½c, 1¼c Class A—24 hr. Unrestricted use 100% of base rate " B—24 " Restricted use 90% " " " C—10 " Unrestricted use 90% " " " D—10 " Restricted use 66⅔% " "
	Power (Flat rate)		10%		H.P. of motors or Peak load: 1-3, 4-10, 11-25, 26-50, 51-100, 101 up Flat rate per H.P. year based on connected load or max. demand: 50.00, 48.00, 45.00, 43.00, 41.00, 40.00 Minimum power factor at max. load to be 80% for motors up to 10 H.P. and 75% above 10%.
Fredericton Gas Light Co., Fredericton, N.B.	Church and Public Bldg. Lighting	20c. per K.W.H.	20%		Buildings having large demands and small consumptions pay a core loss charge of 10c. per month per 60 watts of demand.
	Power	10c. K.W.H. See remarks	10%	$1.00 per H.P. per Mo. for 3 H.P. or more. $3.00 is minimum	Quantity discounts range from 10 to 45%, depending upon consumption and demand. Max. demand for normal operation obtained by test. Bills paid on or before 15th of month only get ½ of the discount allowed on bills paid on or before 10th. Bills subject to 40% discount have 50c. meter rent Bills subject to less discount have 40c. meter rent
Hydro-Electric Dept., Galt, Ont.	Power				Rates for metered and for flat rate power are same as those given at Dundas, Ont., less 10% local discount. There is one exception.— 1 to 10 H.P. under differential rates have fixed charge of $14.40 per year, instead of $14.00.
	Residence Lighting	4c. K.W.H.	10%		Fixed charge of 4c per 100 sq. ft. area lighted plus 4c K.W.H. for current. 90% of outside maximum dimensions multiplied by number of residence floors constitutes the area lighted. Basement and attic not included unless used as living or sleeping apartments.
	Commercial Lighting	12c & 4c K.W.H. See remarks	10%		(a) STORES AND THEATRES 12c. K.W.H. for first hrs. daily use of installed capacity for 26 days monthly plus 4c. for each K.W.H. in excess. (b) SIGNS AND DISPLAY LIGHTING— Same as above or flat rate (c) CHURCHES One-half above rates (d) FACTORIES— Same as (a) if not power users. If so, transformer capacity required for connected lighting load may be added to motor load and all charged at power rate. (e) HOTELS— Same as stores. Peak load may be controlled.
Hamilton Electric Light & Power Co., Hamilton, Ont.	Commercial Lighting (Short Hrs.)	4½c. K.W.H.	10% off Current only	75c. Mo. min. See also fixed charges.	Meter rental 25c. per month. Fixed charge on 2 c.p. lamp per month, .02 " " 4 " " " .04 " " 8 " " " .07 " " 16 " " " .10 " " 32 " " " .20 " " 4 amp arc " .80 " " 6 " " " 1.00 " " 1 Glower Nernst 90 watt lamp per mo. .20 " " 1 " " 100 " " .25 " " 2 " " 110 " " .40 " " 3 " " 110 " " .60 " " 4 " " 110 " " .80 " " 6 " " 110 " " 1.20 " " 20 watt Tungstens .04 " " 25 " " .05 " " 40 " " .08 " " 60 " " .10 " " 100 " " .20 " " 250 " " .45 Carbon lamps, free renewals.
	Residential & Commercial Lighting (Long Hrs.)	2¼c. K.W.H.	10%	See remarks	Minimum monthly guarantees ½ to 20 K.W. $5.00 per K.W. installed 20 to 30 " 4.50 " " 30 to 40 " 4.00 " " 40 to 50 " 3.75 " " 50 to 60 " 3.50 " " 60 to 70 " 3.25 " " 70 to 80 " 3.00 " " 80 and up 2.75 " " Meter rental 25c. per month. Carbon lamps free renewals.
Corporation of Hespeler	Residence Lighting	5c. K.W.H.	10%	See fixed charges	Fixed charge per 100 sq. ft. floor area of 5c. per mo.
	Commercial Lighting	14c & 5c. K.W.H. See remarks	10%	?	(a) STORES AND THEATRES— 14c. K.W.H. for 1st hours daily use installed capacity and 5c. per each K.W.H. excess. (b) SIGNS AND DISPLAY LIGHTING Same as (a). (c) CHURCHES AND LODGE ROOMS— One-half above rates. (d) Same unless power users. If so, add transformer capacity required for connected lighting load to the motor load and charge at power rates. (e) Same as stores.
Ingersoll Elec. Power & Light Commission, Ingersoll, Ont.	Power		10%	See fixed charges	FLAT RATES based on Connected H.P. or on maximum demand; and METERED RATES with fixed charges based on connected H.P. or on maximum demand are on same basis as rates at Dundas, Ont.
Electrical Dept., London, Ont.					Same as Galt, Ont.
London Electric Co. Ltd., London, Ont.	Power	2½c. and 2c. K.W.H.	?	See fixed charges	$10 per H.P. year based on connected load plus 2½c. K.W.H. for small users and 2c. K.W.H. for large users.
Midland Water & Light Commission, Midland, Ont.	Power (Flat rate based on max. demand.		10%		BASE RATE $40.20 per H.P. per year for 1st 10 H.P. $32.64 " " after 1st 10 H.P. 24 HOUR SERVICE— 100% of Base rates 10 HOUR SERVICE— 90% of Base rates 10 HOUR SERVICE (RESTRICTED) 66⅔% of Base rates
	Power Differential Rates	2¼c. K.W.H.	10%	See fixed charges	FIXED CHARGES 24 HR. AND 10 HR. SERVICE $16.20 per H.P. per year for 1st 10 H.P. $12.00 " " after 1st 10 H.P. 10 HR. (RESTRICTED) SERVICE 90% of above charges. METERED CURRENT CHARGES 24 HR. SERVICE— 1st 50 K.W.H. at 2¼c. 2nd 50 K.W.H. at 1½c. All over 100 K.W.H. at ¾c. 10 HR. SERVICE— 1st 50 K.W.H. at 2¼c. less 10% 2nd 50 K.W.H. at 1½c. " 10% All excess at ¾c. " 10% 10 HR. SERVICE (Restricted) 1st 50 K.W.H. at 2¼c. less 33⅓% 2nd 50 K.W.H. at 1½c. " 33⅓% All excess at ¾c. " 33⅓%

METER RATES Continued

COMPANY	Type of Service	Base Rate	Prompt Payment Discount	Min. Rev.	REMARKS
Watrous Electric Light, Power & Traction Co., Watrous, Sask.	Residence Lighting	[illegible] K W H	[illegible]	$1.00 per month	[illegible]
	Commercial Lighting	[illegible] K W H	[illegible]	$1.00 per month	[illegible] special arrangements.
Light & Power Dept., Westmount					[illegible]
Sandwich, Windsor & Amherstburg Ry. Co., Windsor, Ont.	Power	See remarks	10%	$1.00 per H.P. per Mo. up to [illegible] H.P. [illegible] H.P. [illegible] per month.	1st 200 K W H [illegible] K W H Next 200 [illegible] 1000 [illegible] 2000 [illegible] Balance [illegible]
	Commercial Lighting	15c K W H	5%		
	Residence Lighting	12 & 5c K W H	5%	[illegible] per month	4, 5, and 6 Roomed Houses: 1st 10 K W H at 12c K W H; Balance 5c 7 and 8 Roomed Houses: 1st 15 K W H at 12c K W H; Balance 5c 9 and 10 Roomed Houses: 1st 20 K W H at 12c K W H; Balance 5c 11 and 12 Roomed Houses: 1st 25 K W H at 12c K W H; Balance 5c Larger houses in proportion.
Winnipeg Electric Ry. Co., Winnipeg, Man.	Residence or Commercial Lighting	[illegible] K W H	10%	$1.00 month	
	Power	[illegible] K W H			$ [illegible] Month 10% discount [illegible]–$100 15% 100–$200 month 20% Over $200 month 25%
Light & Power Dept., Winnipeg, Man.	Domestic Heating	1c K W H	10%	75c month per K W connected	
	D.C. Power	[illegible] K W H	1 yr. 10% 3 yr. 15% 5 yr. 20% contract	75c Mo. per H.P. connected in no case less than $1 month	
	A.C. Power		1 yr. 10% 3 yr. 15% 5 yr. 20% contract	75c Mo. per H.P. connected in no case to be less than $1 month	1st 50 hrs. use [illegible] at [illegible] K W H Next 50 [illegible] 2 [illegible] 50 [illegible] 1 [illegible] 50 [illegible] 1 [illegible] 50 [illegible] 1 [illegible] Excess over 250 hrs. at 0 [illegible] Wholesale discounts apply on gross bills of over $100 [illegible] Month: For 1st $100 month None 2nd 100 excess over $100 10% discount 3rd 100 [illegible] 200 20% 4th 100 [illegible] 300 [illegible] 5th 100 [illegible] [illegible] [illegible] From $[illegible] to $[illegible] [illegible] [illegible] Excess over $[illegible] [illegible]
	Residence Lighting	3 [illegible] K W H	10%	[illegible] per month	
	Commercial Lighting	3 [illegible] K W H	1 yr. 10% 3 yr. 15% 5 yr. 20% contract	$1.00 per K W [illegible] [illegible] [illegible] in no case less than $1 month	WHOLESALE DISCOUNTS: For 1st $[illegible] month None 2nd [illegible] 10% discount 3rd [illegible] [illegible] 4th [illegible] [illegible] 5th [illegible] [illegible] From $[illegible] to $[illegible] [illegible] Excess over $[illegible] [illegible]
					[illegible]
Electric Dept., Wroxeter, Ont.	Residence & Commercial Lighting	12c K W H	None	[illegible]	[illegible]

METER RATES Continued

Company	Type of Service	Base Rate	Prompt Payment Discount	Min. Bill	Remarks
Cape Breton Electric Co. Ltd., Sydney, N.S.	Lighting	15c K.W.H.	See remarks	$1.00	Meter rental 25c. per month. Quantity discount if payment is made by the 10th 5% on bills between $4 and $10 7½% " 10 and 20 10% " 20 and 35 15% " 35 and 50 20% " 50 and 80 25% over 80
	Arc Lighting	15c K.W.H.	See remarks	$1.00	Same rate
	Auxiliary Lighting				A service charge of $2.50 net per month per kilowatt or portion thereof of connected load or of amount contracted for against which the consumption will be offset at regular rates
	Arc Lighting	12c K.W.H.	See remarks	$2.50 per lamp per Mo.	Meter rental 25c. per month. Electric Co. furnishing lamps on separate meter. This plan applies only on contracts of six months or longer. Quantity discount given as above when bill exceeds minimum
	Employees Residence Lighting	8c K.W.H.	"	"	Given to employees of Electrical Co. No meter rental
	Sign Lighting	6c K.W.H.	None	See Service Charge and meter rent	On separate meters. To apply to installations of 600 watts or more. A service charge of $1 per month plus 15c. per month for each 60 watts installed plus 25c. meter rental, plus 6c per kilowatt hour
	Special	6c K.W.H.	"	"	For agricultural exhibition
	Heating	5c K.W.H.	None	See remarks	On separate meter. For appliances of aggregate capacity of 700 watts per hour or upwards. Meter rental 25c. per month. Minimum charge $1.50 per month for first kilowatt or fraction thereof installed, plus 25c. meter rental and 50c. per month for each additional kilowatt or fraction thereof installed, consumption offset at regular rates
	Power	12c K.W.H.	10%	$1.00 plus meter rent	For motors of less than 2 H.P. capacity rate and discount same as lighting. Meter rental 25c. per month. FOR MOTORS OF 2 H.P. OR OVER INSTALLED 10c K.W.H. for from 0 to 200 K.W.H. 9c " " 200 to 400 " 8c " 400 to 600 " 7c " 600 to 800 " 6c " 800 to 1000 " 5½c " 1000 to 1500 " 5c " 1500 to 2000 " 4c " 2000 to 5000 " 3½c " 5000 and over This last rate to apply only if power is used between 6 a.m. and 6 p.m. Regular minimum $1.00 per month per H.P. installed plus 25c. per month meter rental. Special minimum for auxiliary service $2.50 net per month per kilowatt or fraction thereof of connected load against which the consumption will be offset at regular rates. The Electric Co. reserves the right to indicate the type of motor and voltage of same which shall be installed on its lines
W. A. McKay & Co., Sidney, N.S.	Residence Lighting	11c K.W.H.	None	"	
Teeswater Electric Light Co., Teeswater, Ont.	Lighting	12c K.W.H.			Meter rental 20c. month
Town of Thessalon	Lighting	8c K.W.H.	10% Penalty		Meter rent 50c. every three months. An additional 10% will be charged to all accounts in arrears 30 days from date of notice. Accounts must be guaranteed by a property owner in lieu of a deposit
North Shore Power Co., Three Rivers, Que.	Residence & Commercial Lighting	10c K.W.H.	None	"	
Light Commission Tillsonburg, Ont.	Residence Lighting	5c K.W.H.	10%		4c. per 100 sq. ft. area lighted plus 5c. K.W.H. for consumption. Maximum outside dimensions of building multiplied by number of floors less 10%. Basements and attics not included unless used as living or sleeping apartments
Toronto Electric Light Co. Ltd., Toronto, Ont.	Residential Lighting	8c & 3c K.W.H. See remarks	10%		Charges based on number of rooms in house. Rooms in House — K.W.H. at 8c First 10 K.W. Hrs. — K.W.H. at 3c. Balance 4-5-6 — 10 — " 7-8 — 15 — " 9-10 — 20 — " 11-12 — 25 — " 13-14 — 35 — " 15-18 — 50 — " All houses with more than 18 rooms, 3c. K.W.H. per month per room will be billed at 8c. per K.W.H. all over at 3c per K.W.H.
Toronto Hydro Electric System, Toronto, Ont.	Residential Lighting	3c K.W.H.	10%	See service charges	Total charge is service charge of 4c. per 100 sq. ft. of floor area plus energy charge of 3c. per K.W.H.
Toronto Power Co., Toronto, Ont.					Special rates for a few large customers only
The Chambers Electric Light & Power Co., Truro, N.S.	Light and Power	10c K.W.H.	See remarks	$1.00 Net	Discounts 12½% on 1st $2.00 per month 25 % on next 3.00 " 33⅓% " 15.00 " 50 % all over $20.00 for cash No meter rental
Western Canada Power Co., Vancouver, B.C.	Lighting	See remarks	10%	$1.00	10c per K.W.H. for 1st 50 K.W.H. per month 8c " " 2nd 50 " " 7c " " next 300 " " 6c " " " 300 " " 5c " " " 300 " " 4c " " " 500 " " 3c " all service in excess of 1500 K.W.H. per Mo.
VanKleek Hill Electric Co. Ltd., Vankleek Hill, Ont.	Lighting	15c K.W.H.	30%	"	25c. meter rental per month
Vegreville Electric Light & Power Co., Vegreville, Alta.	Commercial Residential Lighting	12c K.W.H.	"	"	25c. meter rental per month
Walkerton Electric Light & Power Co. Ltd., Walkerton, Ont.	Residential Lighting				No rates for publication, as yet
	Commercial Lighting				No rates for publication, as yet
Walkerville Light & Power Co. Ltd., Walkerville, Ont.	Regular Commercial and Residential Lighting		20%		First 30 K.W.H. at 15c. Next 60 K.W.H. at 10c. All over 90 K.W.H. at 5c. Carbon lamp renewal free
	Special for Industrial Lighting	5c. per K.W.H.	20%	See fixed charge	Plus 50c. net per K.W. connected as fixed charge. Carbon Lamp renewal free
Premier Electric Light & Power Co., Wallaceburg, Ont.	Residence Lighting	10c K.W.H.	None	"	
	Commercial Lighting			"	12c. K.W.H. for 1st 50 K.W.H. per month 11c " 2nd 50 " 10c " next 100 " 9c " all over 200 "

METER RATES—Continued

Company	Type of Service	Rate	Prompt Payment Discount	Min. Bill	Remarks
The Western Gas Co. Ltd., Red Deer, Alta	Lighting	20c K W H	See remark	See remark	[illegible] Bills up to $10.00 [illegible] Bills over $10.00 up to $20.00 [illegible] Min. [illegible] [illegible] [illegible] 100.00 [illegible] Min. $30.00 MINIMUM BILL 10 16 C P [illegible] $1.00 per month and [illegible] additional 16 C P [illegible] per month Meter rental [illegible] per month
	Power	20c K W H See remarks	See remark	$1.00 per month per HP connected load	RATE SCHEDULE First 20 K W H per H P capacity of motor 20c per K W H Next 20 [illegible] 10c " 20 [illegible] " 130 [illegible] 10c The [illegible] power used [illegible] one month [illegible] DISCOUNTS Bills up to $20.00 20% off " over 20.00 up to $30.00 30% off Min. $16.00 " 30.00 up to $50.00 40% off Min. $21.00 " 50.00 50% off Min. $30.00 Company has option of restricting use of current during certain hours
Richmond County Electric Co., Richmond, Que	Lighting	10c K W H	25%		
The West Kootenay Power & Light Co., Rossland, B C	Power, Extracting and refining ore			Amount determined in each case	Special contract drawn up for each individual customer
Eastern Electric & Development Co., Sackville, N B	Lighting	12c K W H			
The Sarnia Gas & Electric Light Co. Ltd., Sarnia, Ont	Lighting	10c K W H	10%		Up to 10 K W H 10c K W H " 100 " 9c " " 500 " 8c " " 1,000 " 7c " Over 1,000 " 6c " Meter rental 25c per month
	Power	See remarks	10%		Up to 50 K W H 7c per K W H. " 100 " 6c " " 200 " 5c " " 500 " 4c " " 1,000 " 3c " Over 1,000 " 2c " Large Special Accounts [illegible] per K W H Net meter rental 25c per month
La Compagnie de Gaz, Elec. & Pouvoir, St Hyacinthe, Que	Lighting	15c K W H	20%		
	Power	10c K W H	None		Power rates are from 10c to 3c K W H according to installation
The St. Johns Electric Light Co., St. Johns, Que	Lighting	15c K W H	See remarks	$1.00 per month	Accounts $1.25 to 6.00 at 11c K W H net 10 days 6.00 to 10.00 at 10½c " 10.00 and up at 10c "
	Power	5c K W H	See remarks	See stand by charges	Discount from 5 to 40% for K W H consumption from 100 K W H to 1000 K W H per month or over Stand by charge at $1.00 per H P installed 25c meter rental
Light, Heat & Power Dept., St. Thomas, Ont	Residence Lighting	5c K W H	10%	See fixed charge	Fixed charge for floor area [illegible] per 100 sq. ft
	Commercial Lighting	12c & 5c K W H	10%		Stores—12c K W H for 1st [illegible] daily use of connected load 5c K W H for all excess Signs—Same or flat rate Churches—One half store rates Factories—House power transformer capacity is added to power load and charged at power rates
St. Maurice Light & Power Co., Shawinigan Falls, Que	Lighting in Shawinigan Falls	6c K W H	10%	See remarks	Reconnection charge of $1.00 for services discontinued for [illegible]. Minimum bill of 50c for 1st 10 lamps and 5c for each additional lamp connected
	Lighting in Nicolet P Q and in Berthierville Que	See remarks	15%	See remarks	RATES PER MONTH 1– 50 K W H at 12c per K W H. 50– 100 " 11c " 100– 150 " 10c " 150– 250 " 9c " 250– 400 " 8c " 400– 600 " 7c " 600–1000 " 6c " 1000–2500 " 5c " 2500 upwards at 4c " Minimum bill of $1.00 per first 10 lamps and 5c per each additional lamp connected Reconnection charge of $1.00 for non payment discontinuance Damage to Company property on consumer's premises, change in equipment unauthorized by the Company, non admittance of Company to customer's premises will make customer liable to a charge of $100.00 or an amount equal to three times the value of the current used or the value of the damages as estimated by the Company
Shediac Electric Light & Power Co., Shediac, N B	Lighting	15c K W H	20%	$1.00 net including meter rental	Quantity Discount—Consumption up to 833 K W H per year net 33%, on all excess over above. Customers charged for reconnection if cut off for non-payment [illegible] damages. Minimum bill per month plus construction expense of connection
City Gas & Electric Dept., Sherbrooke, Que	Lighting	6c K W H	5%	75c	Consumers who are not proprietors of real estate shall deposit $6.00 returnable at disconnection
	Power			See monthly charges	A monthly charge per H P installed — Plus a metered charge of $1.50 — 2c K W H up to 9 H P 1.45 — 1¾c " 10–14 " 1.40 — 1½c " 15–19 " 40c (See below) 67c 20 or more H P 50c 60c 40c if customer owns and maintains transformers 50c if City owns and customer maintains transformers 60c if City owns and maintains transformers Motors driving dynamos not taken at power rates A charge of $1 will be made for each time that more than one connection or disconnection is made within a calendar year
Saugeen Electric Light and Power Co. Ltd., Southampton, Ont	Residence Lighting	9c K W H	None	$1.00 per month	Meter rental 25c per month
	Commercial Lighting	10-12½c K W H	None	⅓ of flat rates	Meter rental 25c per month
	Church Lighting	15c K W H	None	$1.00 per year per 16 c p	Meter rental 25c per month
Light and Heat Commission, Stratford, Ont	Residence Lighting	4½c K W H	10%	See fixed charges	Fixed charge 4c per 100 square ft. floor area per month
Town of Sudbury, Sudbury, Ont	Lighting	15c K W H	33⅓ & 10%		Quantity Discount—10% consumption over 500 K W H per month. Meter rental of 15c per month
Pictou County Electric Co. Ltd., Stellarton, N S	Lighting	15c K W H	See remarks		Quantity Discounts if paid on or before 10th of month $ 1 to $10 — 16⅔% 10 to 20 — 20% 20 to 30 — 25% Over 30 — 33⅓%
	Power	10c K W H			$ 0 to $10 — 10% 10 to 20 — 15% 20 to 30 — 20% Bills over $30 — 25%
[illegible] Mfg. Co., [illegible] N B	Residence Lighting	14c K W H			
	Commercial Lighting	15c K W H			

Company	Type of Service	Net Rate	Prompt Payment Discount	Min. Bill	Remarks
Montreal Light Heat & Power Co. Montreal, Que	Residential & Commercial Lighting	10c K W H	5%		or Up to and including 500 K W H 7½c net K W H 500 to 1,000 7c " 1,000 to 1,500 6½c " 1,500 to 2,000 5¾c Over 2,000 5c Stipulated damages for broken contract 25c per month for each 16 C P equivalent for each month of unexpired term of contract
Saraguay Electric & Water Co., Montreal, Que	Residence	7½c K W H			City
		10c K W H			Suburbs
Shawinigan Water & Power Co., Montreal, Que	Power				Special rates large consumers only
Electrical Dept., City of Moose Jaw, Sask	Lighting Residental & Commercial	8c K W H	10%	$1 00	Meter rental 25c per month
	Ironing Cooking, Heating Small motor	5c K W H	10%	$1 00	No meter rental
	All classes domestic use including lighting	5½c K W H	10%	$5 00	Meter rental 25c per month 5½c rate for all domestic purposes is given only for use during the entire year
	Commercial Lighting		10%		Industrial concerns regularly operating at least five hours per night will be given light at power rates
Water & Light Commission, Mt Forest, Ont					Rates not received in time for publication
Dept of Electric Light & Power, Nelson, B C	Lighting	12c K W H	10%	To be agreed upon	Of total monthly consumption — First 50 K W H 12c per K W H Second 50 " 11c " " Next 100 " 10c " " " 200 " 9c " " " 300 " 8c " " " 300 " 7c " " " 500 " 6c " " " 500 " 5c " " All over 2,000 " 4c " " Meter rental 25c per month
	Power 50 H P and under	5c K W H	20%	$2.00 per month per H P connected	Of total monthly consumption — First 100 K W H 5c per K W H Next 200 " 4c " " " 400 " 3c " " All over 700 " 2c " " Meter rental 50c per month.
The North Bay Light, Heat & Power Co Ltd., North Bay Ont	Domestic Lighting	10c K W H	"	"	Discounts 4-5-6 room house 20 % on 1st 12 K W H and 60% on balance 7-8 room house 20% on 1st 16 K W H. and 60% on balance 9-10 room house 20 % on 1st 20 K W H and 60% on balance 11-12 room house 20% on 1st 25 K W H and 60% on balance
	Commercial Lighting	10c K W H			Straight lighting purposes, 20% Where special line is run into building for heating or special use other than power, 60% discount on all current used above 15 K W H with 20% off the 1st 15 K W H
Electric Light & Power Dept of North Toronto, Ont	Lighting	3c K W H	"	1c per 100 sq ft floor space inside measurement	Total charge is fixed charge or minimum bill plus meter charge
The Ottawa Elec Co., Ottawa Ont	Commercial Lighting	8c K W H	10%		Carbon lamps free Tungsten and others at current prices. Meter rental $1 00 year net Ordinary arcs trimmed 50c monthly Flaming 30c per trim
	Residence Lighting	3c K W H	10%	See area charge	4c per month per 100 sq ft No meter rental Carbon lamps free
	Power Combination Rate	2c K W H See remarks	10%	See remarks	H P — Fixed Charge per H.P year — Meter Charge Per K.W H 1–5 — $ 7 00 — 2c. 5–25 — 8 00 — 1¾c 25–50 — 9 00 — 1½c. 50–100 — 10 00 — 1¼c Over 100 — 11 00 — 1c. The Horse Power to be charged will be the maximum power taken at one time as ascertained by tests; minimum charge is 1 H P
The Ottawa & Hull Power & Mfg. Co Ottawa, Ont					No rates received in time for publication.
Electric Light Dept. Owen Sound	Lighting	8c K W H	20%	"	Also 20% off on consumption over 100 K W.H. per mon Meter Rental 17c per month
Elec. Light & Water Commission Paris	Residence Lighting	7c. K W H	10% penalty	"	
	All other Service	8c K W H	10% penalty	"	
Canadian Electric & Motor Power Co. Ltd., Perth	Light and Power	11c K W H	1c per K W H	"	Meter rental — 5 ampere meter, 15c per month 10 " " 20c " 20 " " 25c. "
The Petrolia Utilities Co. Ltd., Petrolia, Ont.	Light and Power	14c K W H	25%	"	A further discount given for consumption over 300 K W.H. per month.
C A. Julieu, Pont Ronge and St. Raymond, Que	Light	12c K W H	"	"	Meter rental 25c per month.
Commission of Utilities, Pt Arthur, Ont	Residence Lighting	3½c. K W H	10%	See fixed charges	4c. per 100 sq ft lighted area
	Commercial Lighting				STORES AND THEATRES 8c per K.W.H for one hour daily use of installed capacity for 26 days per month and 3c for each K W.H above. SIGNS AND DISPLAY LIGHTING—Same or flat rate option. CHURCHES One-half above rates. FACTORIES Same as stores If they are using power, the transformer capacity for connected lighting load may be added to motor load and charged at power rates. HOTELS Same as stores peak load may be controlled.
Prescott Electric Light System	Light	11c K W H	2c K W.H	"	Meters read about 1st of March, June, September and December
Quebec Railway, Light, Heat & Power Co., Quebec, Que	Residence Lighting	15c K W H	20% Apr 1st to Oct 1st, 33⅓% Oct 1st to April 1st	$1 00 per month	Outside of City same rates only with a minimum of $1 50 instead of $1 00 per month "Stipulated damages" for uncompleted contract 75c per month per 16 C.P. lamp or equivalent for each month or part of month of unexpired term of contract. Lamp renewals if old lamps are returned
	Commercial Lighting	15c K W H	33⅓%	1 K W H per 16 C P	Accounts averaging $5.00 per lamp per year entitled to special discount of 10% Meter rental 25c per month Stipulated damages same as for residential lighting. Lamp renewals if old lamps are returned
	Arcs	15c. K.W.H.	40%		75c per month rental of each lamp 25c per month meter rental
	Power	4c K W H	10% Interest penalty	See fixed charges	Under 200 K W H per month at 4c K W H 200 to 400 K W H per month 200 at 3c K W H 200 at 2 75c " 400 to 600 " " 400 at 2 75c " 200 at 2 3c " 600 to 1,000 " " 600 at 2 3c " 400 at 2 0c " 1,000 to 2,000 " " 1,000 at 2 0c. " 1,000 at 1 5c. " 2,000 to 3,000 " " 2,000 at 1 5c " 1,000 at 1 2c " 3,000 to 5,000 " " 3,000 at 1 2c " 2,000 at 1 0c " 5,000 to 10,000 " " 5,000 at 1 0c " 5,000 at 8c " In addition to above metered rates there is a fixed charge of $1 00 per H P per month based on rated capacity of motors, from 5 H.P and upwards ¼ or ½ H P, $1 00 per month 1 " 1 50 " 2 " 2 50 " 3 " 3 00

METER RATES Continued

Company	Type of Service	Base Rate	Prompt Paym'nt Discount	Min Bill	Remarks
Electric Light Dept Fernie B C	Residence & Commercial Lighting	15c K W H			Up to 250 K W H month 15% Discount 251 to 350 " 25% " 351 to 500 " 30% " 501 to 750 " 40% " 751 to 1000 " 15% "
	Power	See remarks	None	See remarks	$1 00 per H P connected load per month, plus meter rate Up to 150 K W H 10c K W H " 300 " 9c " " 600 " 8c " " 1 200 " 5c " " 2 500 " 3½c " Over 2,500 " 2½c "
La Ville de Fraserville, Fraserville, Que	Residence Lighting	10c K W H	None	50c month	25c meter rental per month 50 K W and over 3% discount 80 " " 5% " 100 " " 7% " 150 " " 10% " 200 " " 15% " 250 " " 20% " 300 " " 25% " 400 " " 30% " 500 " " 35% "
Fredericton Gas Light Co., Fredericton, N B	Residence or Hotel Lighting	20c K W H	10%, if paid before 10th of Mo & 20%, if paid before the 15th	$1 00 per month	50c meter rent
	Commercial Lighting	20c K W H	See remarks	$1 00 per month	$ 5 00 or under per month 20% discount 5 00 to $10 00 " 25% " 10 00 to 15 00 " 30% " Over $15 00 40% " 40c meter rent
Glace Bay, Town of Glace Bay, N S	Residence & Commercial Lighting	10c K W H	None	75c month	Meter rental 25c month
Halifax Electric Tramway Co., Halifax, N S	Residence or Commercial Lighting	15c K W H	See remarks	$1 33 month	Monthly bills From $ 1 33 to $ 9 99 25% discount " 10 00 to 19 99 27% " " 20 00 to 29 99 29% " " 30 00 to 49 99 31% " " 50 00 to 99 99 38% " " 100 00 to over 45% "
	Power	10c K W H	See remarks	$2 22 month	Monthly bills From $ 2 22 to $ 9 99 10% discount " 15 00 to 24 99 20% " " 25 00 and over 30% "
Hamilton Electric Light & Power Co., Hamilton, Ont	Residence Lighting	See remarks	10%	50c month	Meter rental 25c per month K W H rate from 8 5c to 6 6c for variations of current consumption from 10 to 200 K W H per month Lamp renewals free
Hensall Co., Hensall	Lighting	12c. K W H	'	'	Meter rent 20c month
Corporation of Hespeler	Residence Lighting	20c	50%	50 c	Meter rent 15c month
Electric Power & Light Commis'n, Ingersoll, Ont	Residence & Commercial Lighting	10c K.W H.	10%	50c month	
	Signs	6c K W H	10%	50c month	Restricted to certain hours
	Heating	5c. K W H	10%	50c per mo	
La Corporation de La Ville de Joliette, Quebec	Residence & Commercial Lighting	10c. K W H	20%	'	From 0 to 50 K W H at 10c K W H " 51 " 100 " " 9c " " 101 " 150 " " 8c " " 151 " 250 " " 7c " " 251 " 400 " " 6c " " 401 " 600 5c " 601 " 1,000 " " 4c " " 1,001 " 2,500 " " 3c " Over 2,500 K W H at 2c. K W H
Dept of Civic Utilities, Kingston Ont	Residence Lighting	10c K.W H	'	'	
	Signs	6c K W H.	'	'	
	Power		'	'	Up to and over 300 K W H at 6c K W H " " 400 " " 5c " " " 500 " " 4½c " " " 750 " " 3c " " " 1 000 " " 3½c " " " 2,000 " " 2c " " " 3,500 " " 2½c. " " " 5,000 " " 2c "
Brome Lake Electric Power Co, Knowlton, Que.	Residence Lighting	10c K W H		$12 00 year	25c. month meter rental
Electric Dept., Lacome	Residence & Commercial Lighting	20c. K.W H.	See remarks	$1 00 month includ'g meter rent	Accounts up to $30 00—10% discount. From $30 00 to $50 00—15% discount " 50 00 to 75 00—20% " " 75 00 to 100 00 -25% " Over $100 00 month 30% discount 25c meter rental.
Town of Listowel, Ont	Residence & Commercial Lighting	15c K W H.	33⅓%	65c. month	
W. Johnson & Son, Lloydminister.	Residence Lighting		'	'	30c month meter rental 1 to 50 K.W.H. at 15c. K.W H. 50 to 100 " " 14c. " 100 to 150 " " 13c. " 150 to 200 " " 12c. "
	Power	10c. K W.H.	'	'	
Electrical Dept, London, Ont					Same as Galt, Ont.
London Electric Co London, Ont	General Lighting	5c. H W K	10%	None	No meter rental
Electric Light Dept Town of Macleod, Alta	Residence & Commercial Lighting	13c. K.W H	See remarks	'	1 to 150 K W H. month—10% discount 151 to 300 " " —15% " 301 to 500 " " —20% " 500 & above " " 25% "
Corp of Village of Madoc, Ont	Residence Lighting	12c K W H	10% Interest penalty	'	Meter Rent 10-16 C.P. $1 50 year 20-16 " 1 60 " 30-16 " 1 80 " 40 16 " 2 00 " 50 16 " 2 50 " 60 16 " 3 00 "
Mattawa Electric Light & Power Co., Mattawa	Residence & Commercial Lighting	13c K W H	'	'	
Electrical Dept., City of Medicine Hat, Alta	Residence Lighting	8c K W H	'	$1 00 month	
	Commercial Lighting	6c K W H.	'	$1 00 month	
	Power Unrestricted Hours	6c K W H	5% and 10%, See remarks	50c per H P month	50 to 100 K W H 6c 10% Discount 101 to 250 " 5½c 10% " 251 to 450 " 5c 10% " 451 to 650 " 4½c 10% " 651 to 860 " 4c. 10% " 861 to 1,050 " 3½c. 10% " 1 051 to 2,000 " 3c 10% " 2,001 to 3,000 " 2½c 10% " 3,001 to 5,000 " 2c 5% " 5,001 to 25,000 " 1½c 5% " 25,000 and over " 1c Net
	Power Restricted Hours	6c K W H.	5% and 10%, See remarks	50c. per H.P per month	If no current is used from 5 30 P M to 12 P M from Oct to March, 5% discount additional is allowed over above rates
Midland Water & Light Commiss'n Midland, Ont	Residence Lighting	1c K W H	10%	See floor charge	Fixed charge of 4c per 100 sq ft floor area plus metered charge of 1c per K W H
Minnedosa Power Co., Minnedosa, Man	Residence Lighting	15c K W H	Penalty	'	

Company	Type of Service	Base Rate	Prompt Payment Discount	Min. Bill	REMARKS
John Philip, Vil. of Arthur, Ont.	Commercial & Residence Lighting	10c. K.W.H.	None	.	Meter rental 5c per month
	Church, Hall, etc. Lighting	1c. K.W.H.	None	.	Meter rental 5c per month
Barrie Electric Light Departm'nt, Barrie, Ont.	Residence & Commercial Lighting	12½c K.W.H.	20% and 5%	$10 per meter per year	Following additional discounts allowed when half quarterly consumption is 200,000 to 300,000 Watt hours 5 Over 300,000 to 500,000 Watt hours 10 Over 500,000 Watt hours 15 Over 1,000,000 Watt hours 20
	Power	2c. K.W.H.	None	See flat rate charge	1 to 5 H.P. Connected 2c. K.W.H. 5 to 10 H.P. Connected 1¾c. K.W.H. 10 to 20 H.P. Connected 1½c. K.W.H. 20 H.P. and over 1¼c. K.W.H. Plus a flat rate charge of 1.50 per H.P. per month
Electrical Dept., Battleford, Sask.					Rates not received in time for publication
The Trenton Electric & Water Co., Ltd., Belleville, Ont.	Power				No rates for publication as yet
Seymour Power & Electric Co., Bowmanville					Rates not received in time for publication
Brandon Elec. Co., Brandon, Man.	Residence & Commercial Lighting	10c. K.W.H.	5%	$1 per month	25c meter rental per month
	Power	10c. K.W.H.	5% to 50%	"	25c meter rental per month
City of Calgary, Alta.	Power	2c. K.W.H. See remarks	10%	See fixed charges	Up to 750 K.W.H. 2c. 751 " 1750 " 1.8c 1,751 " 3,500 " 1.6c 3,501 " 12,500 " 1.3c 12,501 " 25,000 " 1.1c. A fixed charge of $1 per month up to 20 H.P. 50c. per mo. above 20 H.P., whether the current is used or not. Extra 10% discount if current is not used from 4.30 P.M. to 12 P.M., Oct. to March
	Residence, Signs and Commercial Lighting	9c. K.W.H.		$1.00 per month, whether is used or not	Up to 50 K.W.H. 15% Dis 500 " 20% " 1,000 " 30% " 2,500 " 40% " 5,000 " 45% "
	Church, Hospital, Charitable Institution Lighting	8c. K.W.H.	See remarks	$1.00 per month	Same discounts as above
	Signs	9c. K.W.H.	See remarks	"	Consuming 100 K.W.H. or more 35% cash discount
	Civic Buildings, All Services	4c. K.W.H.	None	"	Parties disconnected for non-payment of accounts are charged $2.00 for reconnection.
Calgary Water Power Co., Calgary, Alta.	Residence & Commercial Lighting	9c. K.W.H.	"	$1 per month whether current used or not	Up to 50 K.W.H. 15% Dis " 500 " 20% " " 1,000 " 30% " " 2,500 " 40% " " 5,000 " 45% "
	Power	See remarks	"	$1 per H.P. per Mo. up to 20 H.P. Each addit'al H.P. 50c per Mo. Whether current is used or not	Up to 750 K.W.H. 2c. less 10% Dis " 1,750 " 1.8c. less 10% " " 3,500 " 1.6c. less 10% " " 12,500 " 1.3c. less 10% " " 25,000 " 1.1c. less 10% "
Town of Camrose	Residence & Commercial Lighting	See remarks	10%	$1 per month whether light is used or not	1st 40 K.W.H. at 18c. K.W.H. All over 40 K.W.H. at 15c per K.W.H.
Chatham Gas Co., Ltd., Chatham, Ont.					Rates not received in time for publication
Town of Claresholm, Alta.					No rates for publication as yet.
British Canadian Power Co., Cobalt, Ont.					Rates not received in time for publication.
Collingwood Water & Light Comm'n, Collingwood, O.	Residence Lighting	12½c K.W.H.	20%	75c. per month	Discounts in addition to prompt payment discount:— Up to $5 none $ 5 to $10 - 5% Dis 10 to 15 10% " 15 to 20 15% " 20 to 30 20% " 30 to 40 25% " 40 and over 30% Dis. Meter rental 10c. and 15c. per month. $1.00 for reconnection if disconnected for non-payment of accounts.
	Power		10% Penalty	See remarks. 50c per H.P. per month	50c per H.P. per month plus current charge of — Up to 200 K.W.H. 5c. K.W.H. 200 to 400 K.W.H. 4c. K.W.H. 400 to 600 " 3½c " 600 to 900 " 3 c " 900 to 1,500 " 2½c " 1,500 to 2,400 " 2 c " 2,400 to 5,000 " 1¾c " 5,000 or over " 1½c. " Meter rental—15c per month
Westbury Electric Light & Power Co., Cookshire, Que.	Lighting	10c. K.W.H.	"	20c per month per 16 c.p.	
Cranbrook Electric Light Co., Ltd., Cranbrook, B.C.	Commercial Lighting	18c K.W.H.	15%	$1.00 per month	Special Consumption discounts: 1 to 100 K.W.H. 15% 101 to 250 " 20% 251 to 350 " 25%
	Residence, Church & School Lighting	18c. K.W.H.	25%	$1.00 per month	351 to 500 " 30% 501 to 750 " 35% 751 to 1,000 " 40% 1,000 and over 45%
	Power	18c K.W.H.	None	See fixed charges	Same consumption discounts as for lighting, plus a fixed charge of $1.00 per H.P. per month net
Creston Power, Light & Teleph'ne Co., Ltd., Creston, B.C.					Do not supply power and light as yet
Dartmouth Gas, Electric Light, Heating & Power Co., Ltd., Dartmouth, N.S.	Residence Lighting	12½c K.W.H.	5% 10%	$1.00 month	5% discount on bills of $6.00 or more monthly; 10% discount on bills of $10 or more monthly
Dauphin Electrical Dept., Dauphin, Man.	Residence Lighting	20c K.W.H.	40%	"	25c Month meter rent
	Power	8c K.W.H.	See remarks	"	40c month meter rent Over $10 and up to $30 month 5% Discount " 30 " 45 " 10% " " 45 " 60 " 20% " " 60 " 80 " 30% " " 80 per month 40% Discount
La Compagnie Electrique de Deschambault, Deschambault, Que.					No rates for publication as yet
Hull Electric Co., Deschene, Que.					Rates same as Ottawa Electric Co.
John Dale, Digby, N.S.	Residence Lighting	12½c K.W.H.			
Dutton Electric Light Co., Dutton, Ont.	Residence Lighting	10c K.W.H.	"	"	Accounts payable every 4 weeks
	Commercial Lighting	1[illegible]c K.W.H.			Accounts payable every 4 weeks

FLAT RATE Continued

Company.	Type of Service.	Prompt Payment Discount.	Remarks.
Quebec Railway, Light, Heat & Power Co., Quebec, Que.	Incandescent Sign Lighting.		10c. per 2 C.P. lamp per month 20c. per 5 C.P. lamp per month 30c. per 10 C.P. lamp per month. 40c. per 16 C.P. lamp per month Time switches required set from dusk to midnight First installment and renewals 20c. per lamp.
	D. C. Arcs, 6 Amp.		All Night $80.00 per year All Night $45.00 summer season (six months). Dusk to midnight $60.00 per year. Dusk to midnight $7.50 per month, winter season.
	A. C. Arcs, 6.6 A.		All night $80.00 per year. All night $45.00 summer season Dusk to midnight, $60.00 per year Time switches for all dusk to midnight A.C. Arcs.
	Power.		1/4 H.P. $25.00 per annum. 1/2 H.P. 40.00 per annum. 1 H.P. 60.00 per annum. 2 H.P. 55.50 per annum. 3 H.P. 50.00 per annum 5 H.P. 45.00 per annum. 7 H.P. 42.00 per annum 10 H.P. 40.00 per annum. 15 H.P. 38.00 per annum. 30 H.P. 37.50 per annum. 35 H.P. 35.00 per annum. 50 H.P. up 30.00 per annum. Broken contract covered by stimpulated damages $4.00 per H.P. per month.
Richmond County Electric Co., Richmond, Que.	Commercial Lighting.	See Remarks.	16 C.P. Carbon lamps and 20 C.P. Tungsten lamps 50c per month each. No prompt payment discount on carbon lamp service, but 20 allowed on Tungsten installation services.
	Household Lights.	See Remarks.	16 C.P. Carbon and 20 C.P. Tungsten 25c. per month. Discounts as per above.
Light, Heat and Power Department, St. Thomas, Ont.	Light.	10	For sign, window or display lighting $6.00 per K.W. connected.
St. Maurice Light & Power Co., Shawinigan Falls, Que.	Lighting at Shawinigan Falls.	See Remarks.	34c. per ea. 32 C.P. lamp per month. 23c. per ea. 16 C.P. lamp per month. 14c. per ea. 8 C.P. lamp per month. Discounts for prompt payment: 4c. per 32 C.P. lamp, each. 3c. per 16 C.P. lamp, each 2c. per 8 C.P. lamp, each
	Lighting at Nicolet and at Berthierville, Que.	See Remarks.	75c. per ea. 32 C.P. lamp per month. 50c. per ea. 16 C.P. lamp per month. 30c. per ea. 8 C.P. lamp per month. 20c. per ea. 6 C.P. lamp per month. Discounts for prompt payment: 15c. per ea. 32 C.P. lamp 15c. per ea. 16 C.P. lamp. 5c. per ea. 8 C.P. lamp. 2½c. per ea. 5 C.P. lamp For special conditions see same under meter rates.
Shediac Electric Light & Power Co., Shediac, N.B.	Lighting.		$1 per month for 165 watts or 3 16 C.P. lamps.
City Gas & Electric Department, Sherbrooke, Que.	Commercial Lighting.	None.	Electric signs and window display lighting—$1.50 per year per 50 watt lamps, lights must be kept burning every night from dusk to 11 p.m. Consumers not owning real estate shall deposit $3.50 returnable at disconnection. Consumers with 6 or less sockets may have option of from 1 to 3 16 C.P. lamps at $5.00 per year, with 5 prompt payment discount, lights to be supplied through controller.
The Saugeen Electric Light & Power Co., Southampton, Ont.	Residential Lighting.	None.	Residences— 25c. per month per 16 C.P. All over 6—16 C.P. at $2.50 per year. 8 C.P. at $1.80 per year. No. 8 C.P. can be installed except on fixtures nor unless at least 5—16 are installed. For winter season only 10% additional. Summer Cottages— 1—5, 16 C.P. at $1.25 each for season of 2 months. All over 5 at $1.00 each. If over 2 months, but not exceeding 5 months 20 will be added.
	Commercial Lighting.	None.	Hotels and Boarding Houses 30c. per month for 16 C.P. Lodge Rooms— $2.00 per 16 C.P. per year. Not more than 2 meetings per month. Churches $2.00 per 16 C.P. per year. Stores All 16 C.P. 35c. per month. All 8 C.P. $2.20 per year. No. 8 C.P. to be installed except in fixtures, and unless current for at least 5—16 C.P. be taken. Must install switch so that all lights except window and 1 lamp in store are turned off when store is closed, otherwise rates are increased 10 . Switch installed free of charge.
Light & Heat Commission, Stratford, Ont.	Residence Lighting.	10	Verandah lights not meter 15c. each per month.
	Sign and Display Lighting.	10	$6.00 per kilowatt connected per month. Load to be balanced.
Cape Breton Electric Co., Sydney, N.S.	Lighting.	5 on bills over $1.00.	1—60 watt lamp or less $1.00 per month. 2—60 watt lamp or less $1.50 per month. 75c. for each additional 60 watt lamp. Above rates include burning from dark to midnight. Double the above rates for all night burning.
	Lighting, Restricted Hours.	None.	For predetermined hours burning approximately 1,500 hours per year and operated from time switch owned and controlled by the Electric Company on installation installed and owned by the Electric Company as follows: Each 100 watt tungsten $1.75 per month net. Free lamp renewals.
	Street Lighting.	See Remarks.	Arcs. 150 watt arcs or lamps producing equal illumination $90.20 per year net. Incandescents. 32 C.P. $19.09 per year net Rebates Rebates allowed for light out: Arcs 24.7c. per night; incandescents, 5.2c. per night. Lights out part of night have proportional rebate.
	Special Rates.	?	For Hospitals, Meteorological Survey, Convents, etc.
W. A. Mackay & Co., Sydney, N.S.	Street Lamp		[illegible] 32 C.P. lamps $17.00 per year.
	Residence Lighting.	?	15c. per month.
	Commercial Lighting	?	60c. per month
Town of Thessalon	Lighting.	10 Penalty.	8 C.P. and under 75c. per quarter 16 C.P. $1.00 per quarter An additional 10 will be charged to all accounts in arrears 30 days from date of notice. Property owner guarantees account

Company.	Type of Service.	Prompt Payment. Discount.	Remarks.
North Shore Power Co., Three Rivers, Que.	Street Lighting.		$50 per 6.6 amp. arc lamp per year. $20 per 64 C.P. incandescent lamp per year.
	Power.		$30 per H.P. year for 5 H.P. and above. Reduced rates to large customers.
	Residence Lighting.		1st 16 C.P. lamp $4.00 per year, or $0.34 per month. 2nd 16 C.P. lamp 3.75 per year, or 0.65 per month. 3rd 16 C.P. lamp 3.50 per year, or 0.94 per month. 4th 16 C.P. lamp 3.25 per year, or 1.21 per month. 5th 16 C.P. lamp 3.00 per year, or 1.46 per month. $3.00 for each additional lamp. For 1 or 2 lamps only, 1st lamp $5.00 per year, or 40c. per month. 2nd lamp $4.50 per year, or 40c per month.
	Commercial Lighting.		(a) Stores— 1st 16 C.P. lamp $5.00 year, or $0.42 month. 2nd 16 C.P. lamp 4.50 year, or 0.80 month. 3rd 16 C.P. lamp 4.00 year, or 1.13 month. 4th 16 C.P. lamp 3.75 year, or 1.44 month. 5th 16 C.P. lamp 3.50 year, or 1.75 month. 6th 16 C.P. lamp 3.25 year, or 2.00 month. 7th 16 C.P. lamp 3.00 year, or 2.25 month. $3.00 for each additional lamp. For 1 or 2 lamps only, 1st lamp, $6.50 year, or 50c. month. 2nd lamp $5.50 per year, or 96c. month. (b) Shops and Barber Shops— 1st 16 C.P. lamp $6.00 year, or $0.50 month. 2nd 16 C.P. lamp 5.50 year, or 0.96 month. 3rd 16 C.P. lamp 5.00 year, or 1.38 month. 4th 16 C.P. lamp 4.50 year, or 1.75 month. 5th 16 C.P. lamp 4.00 year, or 2.09 month. 6th 16 C.P. lamp 3.50 year, or 2.38 month. 7th 16 C.P. lamp 3.00 year, or 2.63 month. $3.00 for each additional lamp. For 1 or 2 lamps only, 1st lamp $7.00 per year, or 59c. month. For 2nd lamp $6.50 per year, or $1.13 per month. (c) Hotels, Boarding Houses and Restaurants— 1st 16 C.P. lamp $7.00 year, or $0.99 month. 2nd 16 C.P. lamp 6.50 year, or 1.13 month. 3rd 16 C.P. lamp 6.00 year, or 1.63 month. 4th 16 C.P. lamp 5.50 year, or 2.09 month. 5th 16 C.P. lamp 5.00 year, or 2.50 month. 6th 16 C.P. lamp 4.50 year, or 2.88 month. 7th 16 C.P. lamp 4.00 year, or 3.21 month. $4.00 for each additional lamp.
The Consolidated Mining & Smelting Co. of Canada, Trail, B.C.	Residence Lighting.		1 to 4—16 C.P. lamps burning till midnight 50c. each per month. 5 or more C.P. lamps burning till midnight 45c. each per month.
	Commercial Lighting.	See Remarks.	Hotels— Bedrooms, dining-rooms and kitchens burning to 9 p.m., 50c. each per month. Hotel offices, restaurants, Chinese laundries, outside lights, light burning all night, $1.25 each per month. Stores— 1 to 6 —16 C.P. burning till midnight, 90c each per month. 7 or more 16 C.P. burning till midnight, 85c. each per month. All night light, $1.20 each per month. Arc lights $7.50 each per month. 32 C.P. lamps double the 16 C.P. rates. Discounts— For 25 lights or over in one building 20% For 40 lights or over in one building 30% For 60 lights or over in one building 33 1/3%
Vankleek Hill Electric Co., Vankleek Hill, Ont.	Commercial and Residential Lighting.	30%	1—10 lts. 16 C.P. 50c. each per month. 10—20 lts. 16 C.P. 40c. each per month. 20—30 lts. 16 C.P. 30c each per month. 30—up lts. 16 C.P. 20c. each per year. 40 watt Tungsten lamps, rate as 1—16 C.P. 100 watt Tungsten lamps, rate as 2 1½ C.P.
	Street Lighting.		$10.00 per year for each 32 C.P. lamp.
Vegreville Electric Light & Power Co., Vegreville, Alta.	Commercial and Residential Lighting.	?	55c. per month for 16 C.P. lamp.
City Electric Lighting Station, Victoria, B.C.	Street Lighting.		Used for municipal lighting only. No rates quoted.
Walkerton Electric Light & Power Co., Ltd., Walkerton, Ont.	Commercial and Residential Lighting.		No rates for publication, as yet.
	Commercial Lighting only.		No rates for publication, as yet.
	Power.		No rates for publication, as yet.
	D. C. Arc Lighting.		No rates for publication, as yet.
Benjamin Mfg. Co., Yarker, Ont.			$2.50 per 16 C.P. lamp per year. 24 hour service.

FLAT RATE Continued

Company	Type of Service	Prompt Payment Discount	Remarks
Montreal Light, Heat & Power Co., Montreal.	Lighting.	†	See same under meter rates.
Department of Electric Light & Power, Nelson, B.C.	Commercial Lighting Monthly.	†	Stores and Offices— 1 to 6—16 C.P. Lamps, $1.00 per mo. per 16 C.P. 7 to 15—16 C.P. Lamps, 75c. per mo. per 16 C.P. Above 15—16 C.P. Lamps, 50c. per mo. per 16 C.P. Hotels, downstairs, same as above. Hotels, up stairs, one-half above rates. Restaurants and all-night light, 9c. per C.P. Arc Lamps (5 Amp.), $7.50 per month.
	Residence Monthly.		One half of store and office rates.
	Commercial and Residence Incandescent Annual Service from Sundown to 1 A.M.	10%	C.P. — Residences. — Offices. 16 — .... — $1.00 32 — .... — 2.00 48 — ... — 3.00 64 — $2.00 — 4.00 80 — 2.50 — 5.00 96 — 3.00 — 6.00 112 — 3.37 — 6.75 128 — 3.75 — 7.50 144 — 4.12 — 8.25 160 — 4.50 — 9.00 176 — 4.87 — 9.75 192 — 5.25 — 10.50 208 — 5.62 — 11.25 224 — 6.00 — 12.00 240 — 6.37 — 12.75 All over (each) — 25c. — 50c. Hotels, boarding houses and lodging houses, for lamps on first floor or in basement, same rates as offices. For lamps above first floor same rate as residences. Private and denominational schools, theatres, drill halls, hospitals, churches, halls of fraternal societies and labor unions, when used less than three nights a week, one-half of rate for residences. More than three nights a week same rate as residences. Lights used between 1 a.m. and 6 a.m. 25% additional on rates.
The North Bay Light, Heat & Power Co., Ltd. North Bay, Ont.	Power.		H.P. RATES PER ANNUM. H.P. — 10 Hr. Limited — 10 H.R. Unlimited — 24 Hrs. 0-50 — $32.00 — $36.00 — $40.00 50-200 — 28.00 — 31.50 — 35.00 200 (and over) — 24.00 — 27.00 — 30.00
The Ottawa Electric Co., Ottawa.	Commercial Lighting, Incandescent.	None.	No. of Lamps. — Charge by Month. — No. of Lamps. — Charge by Month. 1 — $0.35 — 11 — $3.30 2 — 0.70 — 12 — 3.48 3 — 1.05 — 13 — 3.64 4 — 1.40 — 14 — 3.78 5 — 1.75 — 15 — 3.90 6 — 2.10 — 16 — 4.00 7 — 2.38 — 17 — 4.08 8 — 2.64 — 18 — 4.14 9 — 2.88 — 19 — 4.18 10 — 3.10 — 20 — 4.20 Over 20 lamps, 21c. per lamp per month. Carbon lamps 10 to 50 C.P., first outfit free; renewal and Tungsten lamp at current prices.
	Commercial Arcs.	None.	Ordinary 7 amp. lamp or Flaming Arcs of not over 12 amp. x 55 volts, $3.00 per month. Ordinary lamps furnished by Company and trimmed free. Flaming lamps furn'shed by Company, but trimmed at 30c. a trim.
	Special Appliances.	None.	Small Motors, less than 1 H.P. heating devices, etc., cost their equivalent in lamps in the above schedule; every 56 watts of capacity counting as one lamp. When total watts under one contract equal 1 H.P. (746 watts) or greater the power flat rates will apply. Fans and other appliances not used the year around, rate on application.
	Power.	10%	Charges per H.P. per year— 1 to 5 H.P. $29.00 — 25 to 50 H.P. $27.00 5 to 25 H.P. 28.00 — 50 to 100 H.P. 26.00 Over 100 H.P. $25.00.
	Power (Limited).	10%	Applicable where a time switch or other controlling device is used and power is never used between 4 and 10 p.m. from October to March, inclusively. H.P. — Charge per H.P. per year. 1—5 — $20.00 2—25 — 19.00 25—50 — 18.00 50—100 — 17.00 Over 100 — 16.00
The Papineauville Electric Co., Ltd., Papineauville, Que.	Light.	†	1 to 5—16 C.P. Lamps ~~at 8c.~~ each per month. 6 to 10—18 C.P. Lamps at 7c. each per month. 11 and up—16 C.P. Lamps at 6c. each per month.
	Power.	†	1 to 10 H.P. $30.00 per H.P. per year. 11 to 20 H.P. 25.00 per H.P. per year. 21 to 30 H.P. 20.00 per H.P. per year. 31 to 100 H.P. 15.00 per H.P. per year.
Electric Light & Water Commission of Paris.	Lighting.	10% Penalty.	$5.20 per year per each light.
The Petrolia Utilities Co., Petrolia, Ont.	Lighting.	†	40c. per 16 C.P. lamp per month. 80c. per 32 C.P. lamp per month.
C. A. Julien, Pont Rouge, Que.	Lighting.	†	1—16 C.P. 35c. per month. 2—16 C.P. 60c. per month. 3—16 C.P. 85c. per month. 4—16 C.P. $1.05 per month. 5—10 C.P. 25c each per month. 11—15 C.P. 22½c. each per month. 16—25 C.P. 18c. each per month. 25 and more C.P. 16c. per month.
C. A. Julien, St. Raymond, Que.	Lighting.	†	1—16 C.P. $0.40 per month. 2—16 C.P. 0.70 per month. 3—16 C.P. 1.00 per month. 4—16 C.P. 1.18 per month. 5—16 C.P. 1.25 per month. 6—16 C.P. 1.50 per month. 7—16 C.P. 1.75 per month. 8—16 C.P. 1.92 per month. 9—16 C.P. 2.00 per month. 10—16 C.P. 2.09 per month. Over 10—16 C.P. add an additional 16 2/3c. per lamp per month to the charge of the first te nlamps.
	Lighting with Controller.	†	$6.00 per year plus $3.00 per year per each lamp controlled.
Commission of Utilities, Port Arthur, Ont.	Lighting.	10%	For signs, window or display lighting $5.00 per month per K.W. connected.
	Power.	10%	Restricted power $15.00 and $20.00 per H.P. per year. Unrestricted power (24 Hr.) $25.00 per H.P. per year.

Company	Type of Service	Discount Prompt Payment	Remarks
Havelock Electric Light & Power Co., Havelock, Ont	Commercial Lighting	?	(a) Hotel— 50 C.P. lamps, per year, $9 00 32 " " 6 00 24 " " 4 50 16 " " 3 00 8 " " 1 50 (b) Stores and Banks 50 C.P. lamps, per year, $7 50 32 " " 5 00 24 " " 3 75 16 " " 2 50 8 " " 1 25 Arc lamps " 36 00
	Residence and Livery Stable Lighting.	?	Same as Hotels, except 8 C P lamps per year, $1 25
	Blacksmith Shop Lighting	?	16 C P. lamps per year, $1 50
	Arc Lighting	?	$65 00 per lamp per year
Hensall Electric Co., Hensall	Lighting	?	1 16 C P. lamp, 1½c per night 1 8 C.P. or less, 1c night
Corporation of Hespeler, Hespeler.	All Purposes.	10%	$7 00 per month per K W connected on a controller.
Iroquois, Ont.	Residence Lighting	None	4 C P lamp at $0 75 per year each. 8 " " 1 00 " " 16 " " 1 50 " " 25 " " 2 00 " " 32 " " 2 50 " "
	Commercial Lighting	None	(a) Churches, Halls and Rinks— 4 C.P. lamp at $0 50 per year each. 8 " " 0 75 " " 16 " " 1 00 " " 32 " " 2 00 " " (b)—Stores, Shops, Hotel, Offices. 4 C.P. lamp at $1 00 per year each. 8 " " 1 50 " " 16 " " 2 50 " " 32 " " 4 00 " "
La Corporation De La Villue, Joliette, Que.	Residence Lighting.	None	1—16C.P lamp, $5 00 per year each. 2 " " 4 75 " " 3 " " 4 50 " " 4 " " 4 25 " " 5 " " 4 00 " " 6 " " 3 75 " " 7 " " 3 50 " " 8 " " 3 25 " " 9 " " 3 00 " " 10 " " 3 00 per year each, or $30 year. 11-20 " " 2 40 " " 24 " 21-30 " " 2 00 " " 20 " Over 30 " " 1 50 per year each.
	Store Lighting.	None.	$3 00 per 16 C.P. lamp per year.
	Factory Lighting	None.	$30 00 for 10—16 C P. lamps per year, and $1 50 per lamp additional The company shall be entitled to damages to the extent of $20 00 for unadvised change in connected load or for any tampering with meters.
Brome Lake Electric Power Co., Knowlton, Que.	Street Lamps	?	$12 00 per lamp per year.
	Residence Lighting	?	1 lamp, $5 00 per year 2 lamps, $9 00 per year 3 lamps, $12 00 per year. Excess at meter rate
Electric Department, Lacombe.	Residence Lighting.	10%	Up to 2 lights, each 75c month. 3 to 5 lights, each 70c. month. 6 to 9 lights, each 65c. month. 10 and over, 60c. month.
	Commercial Lighting.	10%	Up to 10 lights, each 75c. month. 11 to 20 lights, each 70c. month 21 to 30 lights, each 65c. month. 31 and over, each 60c. month.
	Hotel and Restaurant Lighting	10%	Up to 20 lights, each 75c. month. 21 to 50 lights, each 70c. month. 51 to 100 lights, each 65c. month. 101 and over, each 60c month.
Lakefield Electric Light Co., Lakefield, Ont.	Residence Lighting.	None.	1—16 C.P. lamp, 6c per week.
	Commercial Lighting.	None.	1—16 C P. lamp, 10c. per week.
	Church and Hall Lighting	None	1—16 C.P. lamp, $1 25 per year.
Town of Listowel, Ont.	Residence and Commercial Lighting.	None	1—16 C.P. lamp, $8 00 per year. 2—16 C P. lamp, $14 00 per year 3—16 C P. lamp, $18 00 per year. 8 C.P. lights, at 60% of above rates
Town of Liverpool, N.S.	Residence Lighting.	?	1st 4—16 C P., $3 00 each per year. 1st 3 additional 16 C.P., $2 50 each. Next 3 additional 16 C P, $2 00 each. All above 10 C.P., $1 50 each.
	Commercial Lighting	?	1st 6—16 C P, $5 00 each per year. 1st 5 additional 16 C.P., $4 50 each. Next 5 additional 16 C P, $4 00 each. All above 16—16 C P, $3 00 each.
	Church and Hall Lighting.	?	$1 00 per 16 C P. each per year
	Hotels	?	Special rates.
W. Johnson & Son, Lloydminster.	Residence and Commercial Lighting	?	75c per month per 16 C.P. lamp.
Electrical Department, London, Ont.			Same rates as Galt, Ont.
London Electric Co., London, Ont.	Power	?	For unrestricted 10-hour power a charge of from $30 00 to $50 00 per horse power year, dependent upon amount and hours of service, etc.
Corporation of the Village Madoc, Ont.	Residence Lighting.	10% interest Penalty	1—16 C P light, per year, $2 00 1 Tungsten light, per year, $1 00.
	Commercial Lighting.	10% interest Penalty.	1—16 C P light per year, $4 50.
	Street Lighting	10% interest. Penalty	$4 50 each light per year
	Special Rates	10% interest Penalty	Banks $3 00 per light per year. Churches 1 00 " " Offices 2 50 " " Halls 1 00 " " Hotels 4 00 " " Hotel Stables 3 00 " " Livery 3 00 " " Private 2 50 " " Private Sad Irons 3 00per iron per year Tailors 10 00 " " Hotels 10 00 " "
Mattawa Electric Light & Power Co., Mattawa	Residence Lighting	?	1—16 C P., $0 50 per month 2 16 C P 1 00 per month 4 16 C P 1 20 per month 5 16 C P, 1 50 per month 7—19 C P, 1 75 per month.
	Hotel Lighting	?	30c per light per month
	Stable and Cellar Lighting.	?	30c per light per month
	Outside Lighting	?	50c per light per month

FLAT RATE

Company.	Type of Service.	Prompt Payment Discount	Remarks
Almonte Electric Light Commission, Almonte, Ont.	Commercial Lighting	25 and 5%	8 C.P., 4½c. 16 C.P., 7½c. } Per week, payable weekly 32 C.P., 15c.
	Residential Lighting	25 and 5%	8 C.P., $1 12 16 C.P., 1 80 } Per annum, payable quarterly 32 C.P., 3 60
Town of Annapolis Royal, N.S.	Commercial Lighting	"	From 40c. to 20c. per 16 C.P. lamp per month from 1 to 40 lamps (Each 32 C.P. = 2—16 C.P.) (Each 8 C.P. = ½—16 C.P.)
	Residential Lighting	?	From 30c. to 16c. per 16 C.P. lamp per month from 1 to 40 lamps (Each 32 C.P. 2 16 C.P.) (Each 8 C.P. ½ 16 C.P.)
	Church Lighting.	?	10c. per 16 C.P. per month
John Phillip, Village of Arthur, Ont.	Street Lighting	None	$10 20 per 32 C.P. per year
	Commercial Lighting.	None.	2c. per 16 C.P. per night
Baie St. Paul Electric Co., Baie St. Paul.	Lighting.	?	$6 00 per 16 C.P. per year for one light only. For more than one light.— $5 00 per year for 1st 4 00 per year for 2nd. 3 00 per year for 3rd, 4th, 5th, and 6th 2 50 per year for excess of 6.
Barrie Electric Light Department, Barrie, Ont	Office Lighting.	20%	One and two lights at $5 00 each per year. (Over two lights see meter rates.)
	Residence and Store Lighting	20%	One and two lights at $7 50 each per year. (Over two lights see meter rates.)
	Power.	None	½ H.P. per year, $36 00 ¼ H.P. per year, 18 00. (See meter rates for larger amounts of power.)
Electrical Dept., Battleford, Sask.			Rates not received in time for publication.
The Trenton Electric & Water Co., Limited, Belleville, Ont.	Power		No rates for publication as yet.
Seymour Power & Electric Co., Bowmanville.			Rates not received in time for publication
Brandon Electric Light Co., Brandon, Man.	Residence and Commercial Lighting.	None.	$1 00 per month for 1—16 C.P. light. 0 80 per month for each additional light
Bobcaygeon Electric Light Commission, Bobcaygeon.	Residence and Commercial Lighting	20% Penalty	8 C.P. Lamps, $1 00 per year. 16 C.P. Lamps, 2 00 per year. } Payable quarterly. 32 C.P. Lamps, 4 00 per year Churches and Halls at half rate.
Bridgetown Electric Light & Power Co., Bridgetown, N.S.	Street Lighting	?	$20 00 per 32 C.P. light per yacr. All night service every night.
	Residence Lighting	?	1½c. per light per night for 1 to 6 lights 1¼c. per light per night for 6 to 11 lights 1c. per light per night from 11 up
	Commercial Lighting	?	2c. per light per night for 1 to 11 lights 1¾ per light per night for 11 up.
	Hall Lighting	?	3c. per light per night used.
	Church Lighting.	?	$1 50 per light per year.
Albert MacLaren Electric Light Company, Buckingham, Que.	Commercial Lighting	?	$4 00 per 16 C.P. per year Lodge Rooms, Halls, etc., $2 00 per 16 C.P. per year.
	Residential Lighting.	?	$3 00 per 16 C.P. per year.
	Street Lights	?	6 6 ampere arc lamps all night, $55.00 per year.
	Special.	?	For large customers.
City of Calgary, Alta.	Residence and Commercial Lighting	?	1-16 C.P.—75c. month. Each additional 16 C.P. up to 4—50c. each month. (Over 4 lights see meter rates.)
Chatham Gas Co., Ltd., Chatham, Ont.			Rates not received in time for publication
La Compagnie des Eaux et de l'Electicite Chicoutimi, Que	Residence Lighting	?	1—16 C.P. lamp $6 00 per year. 2— " " 8 00 " 5— " " 19 50 " 10— " " 35 00 " 15— " " 48 00 " 20— " " 55 00 " 25— " " 60.00 " 30— " " 62 00 " Each Flat Iron. 8 00 "
	Commercial Lighting	?	1st 16 C.P. lamp, $7 00 per year 2nd " " 5 00 " 3rd " " 4 00 " 4th " " 3 00 " 5th " " 3 00 "
British Canadian Power Co., Cobalt, Ont.			No rates for publication as yet.
Westbury Electric Light & Power Co., Cookshire, Que	Lighting	?	2 lights, $0 75 per month. 3 lights, 1 00 per month 34c. per month added each light.
Canadian Copper Co., Copper Cliff, Ont.	Lighting	?	20c. per month per 16 C.P. lamp.
Cranbrook Electric Light Co., Limited, Cranbrook, B.C.	Power	None	$6 00 per H.P. per month net
Creston Power Light & Telephone Co., Ltd., Creston, B.C.			Do not supply power and light as yet
Hull Electric Co., Deschenes, Que			Rates same as Ottawa Electric
Dutton Electric Light Co., Dutton, Ont.	Residence Lighting	?	1 light, per year, $5 72 2 lights, per year, $11 44 3 lights, per year, $14 00 Excess at $1 50 each per year Until midnight only and from November 1st to March 1st, from 6 30 a.m. until daylight. (See meter rates.)
	Commercial Lighting		From 1 to 14 lights, 11c. per week From 15 to 19 lights, 10c. per week From 20 to 24 lights, 8c. per week From 25 and over, 7c. per week See meter rates
Kaministiquia Power Co., Fort William, Ont	Power	None	24-horse power service, 2200 volts, 60 cycle, 3 phase, $25.00 per horse power year. Based on rated capacity of motors, but company has right to test for maximum demand, and if same exceeds rated capacity of motors, then maximum demand at 90% power factor shall be taken as basis of contract. Stipulated damages for uncompleted contract $1 00 per horse power per month
Fredericton Gas Light Co., Fredericton, N.B.	Residence Lighting	?	1c. per watt per month. (Use excess indicator and charge 25c. rental per month. See meter and demand rates.)
Galt Municipal Corporation, Galt, Ont	Sign Window and Display Lighting	10%,	$6 00 per month per K.W. connected
Town of Glace Bay, N.S.	Residence Lighting	None	Up to 5 lights, 33c. per 16 C.P. per month 6 " 7 " 31c. " " " 8 " 9 " 30c. " " " 10 " 12 " 27c. " " " 13 " 16 " 25c. " " "
	Commercial Lighting	None	(a) Stores 40c. per 16 C.P. per month (b) Hotels. Lights in office, bar, public rooms, etc., 50c. per 16 C.P. per month. Kitchen, dining rooms and bedrooms, same as residence rates

Proceedings of the

Twenty-Second Annual Convention

of the

Canadian Electrical Association

HELD AT OTTAWA, ONTARIO

June 19th, 20th and 21st

1912

Office of the Association

BIRKBECK BUILDING,

12 Adelaide Street East,

TORONTO, ONT.

Canadian Electrical Association

Officers 1912-1913

President:
W. L. BIRD.
Kaministiquia Power Co., Fort William, Ont.

1st Vice-President:
P. H. KEMBLE,
Toronto Electric Light Co., Toronto, Ont.

2nd Vice-President:
R. H. SPERLING,
British Columbia Electric Railway, Vancouver, B. C.

3rd Vice-President:
J. S. NORRIS,
Montreal Light, Heat, & Power Co., Montreal, Que.

Honorary Secretary:
T. S. YOUNG,
220 King St. W., Toronto, Ont.

Secretary-Treasurer:
C. E. BOWDEN,
Toronto Electric Light Co., Toronto, Ont.

Managing Committee:
A. A. DION,
Ottawa Electric Co., Ottawa, Ont.
A. L. MUDGE,
Electric Power Co., Toronto, Ont.
W. L. ADAMS,
Ontario Power Co., Niagara Falls, Ont.
I. H. WRIGHT,
North Bay Light, Heat & Power Co., North Bay, Ont.
P. H. KEMBLE,
Toronto Electric Co., Toronto, Ont.
D. H. MCDOUGALL,
Toronto Power Co., Toronto, Ont.
R. S. MCDUNNOUGH,
North Shore Power Co., Three Rivers, Que.
W. C. HAWKINS,
Dominion Power & Transmission Co., Hamilton, Ont.
H. G. MATTHEWS,
Quebec Railway, Light and Power Co., Quebec.
T. A. CHISHOLM,
St. John's Electric Light Co., St. John's, Que.
D. R. STREET,
Ottawa Electric Co., Ottawa, Ont.
WILLS MACLACHLAN,
Trenton Electric Co., Trenton, Ont.
E. L. MILLIKEN,
Cape Breton Electric Co., Sydney, C.B.
W. PHILLIPS,
Winnipeg Electric Railway Co., Winnipeg, Man.

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PROCEEDINGS

PROCEEDINGS OF THE TWENTY-SECOND ANNUAL CONVENTION HELD AT THE CITY OF OTTAWA, JUNE 19, 20 and 21, 1912.

On Wednesday, June 19th, at ten o'clock a.m., the President, Mr. A. A. Dion, called the meeting to order, and introduced Acting Mayor Hinchey, of Ottawa.

Acting Mayor Hinchey: Mr. Chairman and Gentlemen,—I can assure you it affords me a very great deal of pleasure, indeed, to be permitted to say a few words to such a prominent gathering of electrical men from different parts of this country. As it is quite possible that misunderstanding may crop up, and as I always refrain from sailing under what might be called false colors, I think it proper for me to explain that I am here this morning merely in the capacity of a substitute. His Worship, the Mayor of Ottawa, as you know, is unavoidably absent. He left here on Saturday last for the Old Land, and, as a consequence, I have had to step into the breach. For your sake I regret exceedingly the absence of His Worship, because if he were present he could have addressed you in a far more interesting manner than I am capable of doing. However, I can truthfully assure you that while I lack that eloquence of speech for which our Mayor is noted, I am by no means wanting in sincerity, and on behalf of the citizens and Corporation of the City of Ottawa I extend to you a sincere and cordial welcome. This city, which you have seen fit to favor as your meeting place, is made up of a population of about 100,000 souls. We are a happy and contented people living under local conditions which we have ourselves created, and we enjoy to the fullest extent the liberty and freedom that is inherent to citizenship in the great British Empire. Perhaps I can in no way illustrate the condition of feeling in this city better than by referring to an incident which took place in our fair city not very long ago. It is some years, it is true, but it is still fresh in my memory. I refer to the occasion when their then Royal Highnesses, the Duke and Duchess of Cornwall and York, were so good as to favor our city with their distinguished presence. That was a memorable event which we all appreciated, and I may say that extensive preparations were made by the Dominion Government, by the Corporation of Ottawa, and, in fact, by the citizens generally to receive their Royal Highnesses, but there was one item on the programme which impressed me more strongly than any others, and that was a feature that was arranged by the two School Boards of this city—the Public and Separate School Boards. Those two bodies united, and without a dissenting voice it was decided to assemble

the school children of the respective schools with a view to singing songs of welcome to their Royal Highnesses. A large stand was erected on Parliament Hill, and on the memorable day when the Royal party arrived they found awaiting their coming thousands of school children of this city. They found seated side by side on a common platform the sons and daughters of Public and Separate School supporters, of Protestants and Roman Catholics, children whose origin was of different nationalities, but all true loyal Canadian boys and girls who had assembled together on a common platform for the purpose of singing patriotic songs to welcome that Royal Prince who has since become our esteemed and beloved Sovereign. Now, it would be out of place if I were to trespass to too great an extent upon your time. You are assembled here for the purpose of transacting business, and it is not my intention to infringe to any great extent upon your time. I may say that we look forward with pleasure to meeting you at the hotel in Aylmer this evening. Your esteemed President, Mr. Dion, has been kind enough on behalf of your Association, to extend to my confreres on the Board of Control, as well as myself, an invitation to attend a banquet which you propose holding in this hotel to-morrow evening, for which I thank you. Before concluding, let me venture to express the hope that you may benefit both collectively and individually as a result of your conferences in this city, and I sincerely trust that this visit will be the forerunner of many others which may follow in the future. (Applause.)

The President: On behalf of the Association I wish to thank you, Mr. Mayor, for your kindness in coming here this morning to welcome our visitors. I am sure this act of yours is very much appreciated. We hope to have you again with us and to hear further from you on the occasion of the banquet to which you have referred.

The next item on the programme this morning is the traditional President's Address. It is a function which it seems cannot be avoided, but I shall not inflict any lengthy address upon you.

PRESIDENT'S ADDRESS.

Gentlemen,—It gives me a great deal of pleasure to welcome you in this my home city and on behalf of the Ottawa members of the Association and their friends I bid you a hearty welcome.

It is eleven years since we met in this city. Then, as now, I had the honor to preside at our sessions.

I am doubly proud to be privileged to preside at this Convention, because it marks the coming of age of our Association.

Twenty-one years ago a few men interested in electrical enterprises met in Hamilton and laid the foundations of this Society, which, if it has not reached our highest ideals, has, at least, endured until this its majority, doing excellent work meanwhile.

While we are able to give you decent accommodation in this hotel, we regret that owing to the otherwise gratifying march of civic improvements, things roundabout are a little upset. We would like to receive

you with our best clothes on, but you will notice, at any rate, that this city is progressing and to this progress the electrical industries have contributed their full share.

We have provided a programme of entertainment which we trust you will thoroughly enjoy.

The membership of the Association, as the Secretary will tell you in his report, shows a healthy increase, but it is to be regretted that the efforts put forth by the Managing Committee, the Secretary and the Membership Committee, have not resulted in all that we might have reasonably expected. There are still too many companies outside the folds. However, there is reason for congratulation in the growth of the company sections, of which we have five, in a flourishing condition, namely, at Toronto, Montreal, Ottawa, Hamilton, and Vancouver. These sections are doing excellent work for the companies that have them in increasing the loyalty and usefulness of the employee members to their respective employers. There are other matters of interest of which I would like to speak, but they will be more properly discussed at the Executive sessions to be held later in the week. I must say a word here, however, regarding the intended resignation of our honored and efficient Secretary, of which he will speak in his annual report. We all regret, I am sure, and I, as much as anyone, that he finds it necessary to take this step. It will be difficult to replace him. As an old member of the Managing Committee, it gives me pleasure to hear testimony, if any testimony is required, to his untiring zeal, and devotion to the interests of our Association.

I thank you, gentlemen, for your confidence and for the honors you have thrust upon me since I have become actively interested in the Association, in keeping me for many years on your Managing Committee and in electing me on three different occasions to the Presidency. It is time for me to retire from office and make room for others, with new ideas and new plans for the greater effectiveness of this Society, and I am grateful that you have allowed me to round up my official career by meeting you in convention in my own city.

I trust that this meeting will be both pleasurable and useful to us all, and that our Association, having now reached man's estate, will prosper and do for its members more than ever before, as our needs and difficulties are, perhaps, greater than ever before.

The President then asked the Secretary to read the Minutes of the last meeting.

It was moved and seconded, that the Minutes be taken as read, and on the motion being put the President declared the motion carried.

The Secretary then read the communications.

The President then asked the Secretary, Mr. T. S. Young, to read his annual report.

SECRETARY-TREASURER'S ANNUAL REPORT.

To the Members of the Canadian Electrical Association:

The adoption last year of a new Constitution as a result of the affiliation with the National Electric Light Association makes it impossible to submit comparative figures which would be intelligible. Concurrent with the affiliation a new schedule of fees went into effect, and the work of the past year has been largely building on a new foundation. While some of the former members of the C. E. A. have not joined since the affiliation, there has been a gratifying growth in the membership through the Company Sections in Toronto, Ottawa, Montreal, Hamilton and Vancouver. Taking the Dominion as a whole, however, it would appear that the Directors of many Central Station Companies do not yet realize as they should the advantages to be derived from organization, from studying the results obtained by and the successful methods of other Companies. I say ''directors'' because the benefits must accrue to the Company and because the C. E. A. will never broaden and expand as it should until greater support is forthcoming from those who actually represent the invested capital.

The Managing Committee held three meetings during the year, in September, January and April. At the September meeting it was decided to hold the Annual Convention in Ottawa, and Mr. R. G. Black was appointed Chairman of the Papers Committee. Subsequently, owing to Mr. Black's absence in Europe, Mr. J. H. Larmonth assumed the duties of this Committee. The question of extending an invitation to the Institution of Electrical Engineers of Great Britain was discussed and it was decided to take no action this year.

Several changes have, of necessity, taken place in the Managing Committee during the year. Mr. C. E. A. Carr, Quebec, resigned, owing to his removal to New Orleans, La., and Mr. H. G. Matthews, his successor as manager of the Quebec Railway, Light & Power Company, was elected in his place. Mr. J. W. Crosby, of Halifax, tendered his resignation owing to his inability to attend the meetings, and Mr. H. C. Foss, manager of the Cape Breton Electric Company, Sydney, N.S., was elected as his successor. Mr. Foss has since removed to the United States. Mr. J. W. Purcell, having severed his connection with the Walkerville Light, Heat & Power Company, also tendered his resignation recently.

Since our last Convention new members have been elected as follows:

Class ''A''—(Central Station Companies)..........	14
Class ''B''—(Officials and Employees of Central Stations).........................	274
Class ''C''—(Invited Members)..................	25
Class ''D''—(Manufacturers, Supply Firms, Consulting Engineers)..................	3
Class ''E''—(Employees of Manufacturers and Supply Firms).........................	37

Two Class "A" members have been lost, owing to their plants being purchased by the municipality.

The membership of the Association May 31st, 1912, was as follows:

Class "A"	48
Class "B"	448
Class "C"	27
Class "D"	9
Class "E"	54
	586

The company sections have the following members: Toronto Electric Light Company, 194; Ottawa Electric Light Company, 105; Hamilton Electric Light & Power Company, 54; British Columbia Electric Railway Company, 46; Montreal Light, Heat & Power Company, 28. Some new members have recently been taken in, which will increase the number in some cases.

On the basis of the present membership the annual revenue would be:

Class "A" members	$ 765.00
Class "B" members	2,240.00
Class "C" members	135.00
Class "D" members	180.00
Class "E" members	270.00
	$3,590.00

As the National Electric Light Association receives one-half the fees, the income for our Association would be $1,845.00. This amount, in my opinion, is not sufficient to properly carry on the work of the Association and emphasizes the necessity of increasing our membership or devising some other means of securing greater revenue.

It seems advisable that the financial statement should run concurrent with the Association year, which is also the calendar year, and, consequently the accompanying statement covers only seven months, from June 1st to December 31st, 1911.

The financial position of the Association on May 31st, after deducting outstanding accounts, including $1,083.97 due the National Electric Light Association, showed a small debit balance, but dues for this year to the amount of $1,375.000 were still unpaid. Of this amount $455.00 has since been received, covering the dues of members of the Ottawa Electric Light Company section.

The entertainment expenses of last year's Convention were $571.70. and the contributions $500.00.

FINANCIAL STATEMENT.

Balance on hand, June 1st, 1911 .... $ 792.35

Receipts.

Membership Fees	$1,227.35	
Convention Contributions	500.00	
Guests' Privileges	30.00	
Sale of 200 copies G. R. Smith's Paper	7.00	
Interest	6.75	
		1,771.10
		$2,563.45

Expenditures.

Printing of Proceedings and Papers, 1911 Convention	$ 283.08	
Engravings for Illustration of Papers, etc	21.43	
Stenographic Report, 1911 Convention	75.00	
Grant to Secretary-Treasurer	500.00	
Convention Expenses	571.70	
Office Rent	75.00	
Convention Badges	73.17	
Clerical Assistance at Convention	20.30	
General Printing	82.85	
Printing 1,000 Constitutions	24.65	
Postage	95.00	
Stenographer's Salary	240.00	
Office Furniture	38.50	
Circular Letters	39.23	
Stationery and Office Supplies	34.15	
Bond for Secretary-Treasurer	5.00	
Expenses, Managing Committee Meetings	20.00	
Telegrams and Sundry Expenses	7.80	
Refund of unpaid dues per arrangement with N.E.L.A.	102.91	
		$2,309.77
Balance in Bank and on Hand		253.68
		$2,563.45

My resignation as Secretary-Treasurer has been in the hands of the Managing Committee for some time, and in severing my official connection with the Association I desire to express my appreciation of the courtesy and consideration shown me at all times by the officers and members. The time has come when I believe the interests of the Association will be advanced by my retirement, as I have not been able to do the Association justice during the past year.

Respectfully submitted,

T. S. YOUNG, Secretary-Treasurer.

AUDITORS' REPORT.

Toronto, June 1st, 1912.

To the President and Members of the Canadian Electrical Association:

We hereby certify that we have audited the Cash Book from June 1st, 1911, to December 31st, 1911, and found same correct.

L. V. Webber,
A. L. Mudge,
Auditors.

Mr. Frederic Nicholls: Do I understand the number of 48 Class A members constitutes all the company members that belong to the Association?

The President: All the operating companies.

Mr. Nicholls: Do the Class B members, numbering 448, all belong to the manufacturing and supply companies?

The President: No, these are employees of the operating companies. Class D is composed of manufacturing companies, and Class E of employees of manufacturing companies.

I may say in connection with the expenses, that this Convention will not cost the Association anything except for the Secretary's expenses. No part of the entertainment will be charged to the Association.

Mr. R. F. Pack: I move the adoption of the Secretary-Treasurer's report. At the same time I should like to express my personal regrets, and I am sure the regrets of every member of the Association upon the retirement of the Secretary-Treasurer, Mr. Young. I suppose it is useless to use any persuasion, but if any persuasion would be of the slightest use I am sure every member present would join with me in urging Mr. Young to continue the work he has done for the Association. (Hear, hear.)

Mr. A. L. Mudge: I second the motion.

The President: In putting this motion, coupled with an expression of regret for Mr. Young's severance from active participation in this Society, I feel the loss we are going to suffer very much, indeed. If I thought that persuasion was of any use I would certainly use it. I may say we have already used some, but it is quite certain that Mr. Young cannot continue to fill the office. He has filled it with very great devotion to the interests of this Association for many years and I would ask you to take a standing vote on this motion.

Mr. Nicholls: Before that standing vote is put, Mr. Chairman, I want to say I am quite at one with Mr. Pack's motion expressing regret at the loss of our Secretary, but I would like to go a little further than that. I think that that expression of regret should take some more tangible form, and at least be put in the shape of an illuminated address, expressing the regret of the Association at losing his services, and appreciation for his past services. I will move that that be done.

Mr. P. H. Kemble: I second the motion.

The President: I would suggest that the mover name a committee to carry this out.

The President put the motion, which, on a standing vote being taken, was declared carried.

Mr. T. S. Young: Mr. President and Gentlemen,—I assure you I heartily appreciate this expression from the members of the Association. I have served the Association for six years as Secretary-Treasurer, but it is a fact that for twenty years I have been hovering around the Secretary's office, and, naturally, I have formed a fondness for and a loyalty to the Association. It is with very great regret that I am now about to sever that connection. I am conscious of the kindness and consideration which has been shown me at all times by the members, and by the officers of the Association, and while I am severing my active connection with the Association, I hope still to attend the Conventions, and to do what I can to further the interests of the Canadian Electrical Association. I thank you most sincerely for your kind words and for this standing vote. (Applause.)

The Secretary-Treasurer then read the correspondence.

The President: We have the pleasure of having with us this morning Mr. Frederic Nicholls, of Toronto, one of the oldest members of this Association, a gentleman at the head of a very large corporation, and a gentleman who has given us on many occasions words of very wise counsel. I wish to express my appreciation at Mr. Nicholls' presence here to-day because he is here at considerable inconvenience. He is not able to remain with us any longer than to-day, and as he will not be with us at the banquet to-morrow evening, I should like to ask him to address the Association on any subject on which he may wish to speak. (Applause.)

Mr. Nicholls: Mr. Chairman and Gentlemen,—I do not know that I wish to say very much to the Association, except to take objection to one of your remarks which you intended to be very complimentary. I object to being referred to as one of the old members of the Association. I am one of the young members who has been a member of the Association for a long time. (Hear, hear.)

Now that I am on my feet I sincerely wish to express my regret to you, sir, and to the Managing Committee, at my inability to remain longer. I intended to have been here and to have taken my share in the Convention, but circumstances make it imperative for me to go back to Toronto. I consider it a privilege to be here and join with you all once a year. I have made many good friends at the different meetings of the Association, and I think it certainly contributes to the welfare of the electrical business as a whole. This is not an occasion to make any set speech, and I regret very much that circumstances have made it necessary for me to decline the honor of addressing the banquet to-morrow night.

There being no general business to bring forward, the President called for the report of the Membership Committee.

The President: I wish to say that Mr. D. H. McDougall, who was to give this report is unable, through illness, to be present. I have been informed that he has no formal report to present. All there is to report is really what you have heard in the Secretary-Treasurer's report as to the increase in membership. The committee has been active during the year in trying to increase the membership, and you have heard the result.

The next item is the report of the Meter Committee, and we will hear that now.

Mr. L. V. Webber (Chairman).

REPORT OF THE METER COMMITTEE TO THE 22ND ANNUAL CONVENTION OF THE CANADIAN ELECTRICAL ASSOCIATION.

The Committee begs to present the following report.

In the past, meter practice and the types of meters used have been determined to a considerable extent by the production of a few of the large manufacturing companies, who, protected by patent rights and import duties, have been able to develop their meters according to the best ideas of their engineers, without being too much hampered by the pressure to produce a cheaper type at the sacrifice of efficiency.

In many cases the relations between the manufacturers and the companies have been such that they have found it to their mutual advantage to use exclusively the apparatus produced by certain of the manufacturing companies.

There are, however, a number of manufacturers now selling meters in Canada, who, until recently, did not consider the Canadian market worth while, or, at any rate, left the selling of meters in central stations to manufacturers' agents, who, perhaps, did not bring out the finer points of the meters sufficiently to interest this market.

This has had a beneficial effect in giving a greater variety to choose from and in introducing some features which improve the general efficiency of meters.

Some of these European manufacturers have, as far as possible, adopted Canadian styles to meet the demands of this market. This especially applies to single phase meters which some of the companies have been using sufficiently long to know that they are giving very good results.

There appears to be an extensive field for demand meters and indicators. A combined integrating and demand meter is being put on the market which may prove useful.

The maximum demand meter is of chief importance in connection with the sale of large blocks of power, especially where polyphase current at high potential is used, as these contracts are usually made on the demand basis.

One type of maximum demand meter is made with an indicator which is moved and left at the maximum, the time lag being adjustable. This meter has the advantages, that the maximum demand can be read at once from the dial, and that it is very easy to maintain. It has these

defects, viz: that no record of the demand is obtained other than that taken by the reader, and that the time at which the maximum demand occurred is not indicated.

Another type is the curve drawing instrument.. The maximum demand is obtained directly from the curve, from which also the time and duration of demand may be read. This has proved to be a most satisfactory instrument if maintainance charges are not too high, compared with the revenue received.

The period at which meters should be tested was also discussed by your Committee, and where induction meters only are used, the best system for the smaller operating companies to follow, is that the meters which register the largest amount of current should be tested frequently, as any slight variation would mean more extensive error than if there was a smaller consumption. Smaller meters should be tested every 18 to 24 months.

Your Committee would recommend the purchase of at least one copy by each central station of "The Meterman's Handbook," prepared by the Committee of our affiliated Association, because of the valuable technical information contained therein.

Your Committee discussed the part of the Inland Revenue report which applies to the testing of electricity and gas meters, and decided to wait until the new schedule has been longer in force before taking any action in regard to rates charged.

In conjunction with the Canadian Gas Association, it was decided to send a memorial to the Minister of Inland Revenue, requesting his favorable consideration for some changes in the Gas and Electricity Act, which concern and greatly affect the companies and the Canadian public.

THE METER COMMITTEE.

Mr. Mudge: In moving the adoption of this report I would like to draw attention to the fact that a most elaborate and comprehensive report was submitted last year by the Meter Committee, and this year's report is, perhaps, more in the nature of bringing it up to date, so that the two reports should be considered together as being the latest work that has been done and very satisfactorily done, by the Meter Committee. Particular reference is made to a type of watt meter which will be of considerable use in certain central station works. That is an integrating watt meter which has a maximum demand attachment. In the past this type of meter has been rather complicated and expensive, but I think things are moving in the right direction, and no doubt further improvements will be made in the near future which will allow of a much greater use of this type of meter.

L. W. Pratt: Mr. President, I have very much pleasure in seconding the adoption of the report of the Meter Committee, and I would like to express my appreciation, and I think the appreciation of the rest of the members, too, of the very useful work which has been done by Mr. Webber in connection with the Meter Committee for the past four or five years. In his report he refers to the "Meter Man's Handbook," which has been

published at considerable expense by the National Electric Light Association. I notice that only a very limited number of copies are being printed and it behooves everyone to get his orders in early. It involves a large number of pages with some seven hundred illustrations, and goes into the meter side of the business most thoroughly.

Mr. Pack: Before this report is finally adopted I should like, if I may, to call the attention of the manufacturers to two remarks made by the Committee in the report. One is the necessity of a maximum demand meter in conjunction with an integrating watt meter. Mr. Webber thinks that this meter will be used principally for large installations, in which case the cost of the meter is not of such vital importance. Personally, I am inclined to think that the general trend of affairs is towards the use of maximum demand meters for comparatively small installations. If that is so it will be absolutely necessary for the manufacturers to turn out a meter that is fairly accurate and efficient and at the same time the cost must be extremely low. The revenues received by the companies in Canada at the present time, from the smaller users of current are exceedingly small, and if it is necessary to instal an expensive type of meter to measure the maximum demand as well as the current consumption the companies are going to be very severely penalized. I think, too, I should call the attention of the manufacturers to the necessity of reducing as much as possible the cost of the integrating watt meter for residential purposes.

Mr. A. B. Lambe: It seems to me that the question of the cost of watt hour meters is very largely in the Association's own hands, or in the buyer's own hands, because if you demand great accuracy and a guarantee that is very onerous, the cost has got to go up and stay up; on the other hand, if you are satisfied with a meter with characteristics not quite as good, then the manufacturer can bring out a design which is of much lower first cost.

The President: In connection with this subject, I have been requested by a member of this Association, Mr. F. A. Cote, of Sorel, Quebec, to read a short communication.

The President: The report of the Meter Committee mentions a maximum demand attachment. It might be interesting to this meeting if this attachment was described a little. I am not familiar with it myself.

Mr. Webber: There are two or three styles that have been put on the market recently. I should not like to give an opinion as to whether it would be advisable for the members of the Association to adopt any one particular type, as they are a comparatively new thing with us. There are two companies which make an integrating watt-hour meter with a demand attachment. The time lag on the demand is adjustable. If this meter could be produced at a fairly reasonable price it would meet the demand which is so evident with the larger companies in Canada to-day.

The President: Is it much more expensive than the ordinary meter?

Mr. Webber: One manufacturer sells the attachment at an extra cost of about $30.00 on the price of the meter. This would suit any size meter up to 80 amperes.

The President: That would be a large meter for a small consumer.

Mr. Webber: If these meters could be manufactured at a cost of about $15.00 up to 25 amperes, they would meet the demand for use with the small consumer.

Mr. Wills Maclachlan: Mr. Lambe brought up a question I should like to go into, and that is the question of having a more efficient meter. I would like to know if the limit set by the Government will allow for any reasonable reduction in the price. I understand the limit set now is three per cent. either fast or slow. Would that three per cent. be of any advantage in decreasing the price of the meter?

Mr. Lambe: I would disagree with that. The Government's limits are very wide, three per cent. either way; further, they do not say at what load, and they take no account of power factor, or anything of that sort. Again, they allow a four per cent. variation in voltage, and a four per cent. variation in frequency, so that it is the consumers' demands, I think, which control the meter and make it what it is. For instance, if you buy under a contract with guarantees attached I think that to-day nearly every company will ask for starting at at least one-half of one per cent. of load, and I have seen some requirements which were even worse than that. Thus you see that our limits, which are three per cent, either way, are much outside the ordinary commercial requirements.

Mr. W. B. Morrow: Are slot meters on the market now in general use?

Mr. Webber: I think the President's company has had some experience with them. There are some being sold in Canada at the present time. They have been more successful during the last two years than they were previously, when the slot apparatus in gas meters seems to have held the field, but lately there have been some electric prepayment meters which have proved a success.

Mr. President: It may be interesting for some of you to know that we are using probably five hundred electric slot meters. Some are of American make and others are of European. Both are giving fair satisfaction, and the secretary-treasurer of our company reports that it is a very great assistance to him in retaining customers that he could not otherwise keep on his books, and where there is a competing company, this, of course, is an advantage.

The President put the motion to adopt the report, which, on a vote being taken, was declared carried.

The President then called for the report of the Commercial Committee.

Mr. T. F. Kelly (Chairman).

REPORT OF THE COMMERCIAL COMMITTEE

It seems unfortunate that the work this Committee was formed to do in 1911 was marred by member companies not responding to requests for information very readily and, this year, your present Committee had less than one month to collect data and compile it so that it might be printed in time for this Convention.

In the very short time at our disposal, it was considered unwise to take time to call a meeting of the Committee to compile a set of questions. The Chairman, therefore, took it upon himself to hurriedly prepare a number of questions to mail to the member companies, and should any fault be found with the questions prepared, blame the Chairman; but should the Report be found to be of interest, thank the Committee, for without their assistance replies would not have been received and this Report would certainly have been a dismal failure.

In presenting this Report the Committee wishes to thank the member companies who answered the questions to enable this Report to be prepared.

It might be noted here that of the forty-five (Class "A") member companies of this Association, eleven did not answer the questions. It is only fair to add here that the reason the Canadian Niagara Power Company and the Ontario Power Company, of Niagara Falls, did not answer was, no doubt, because their entire output is practically sold wholesale, and for that reason they were unable to furnish information of any value to us. It was for this reason that, while the Kaministiquia Power Company, of Fort William, and the Toronto Power Company, Limited, of Toronto, returned the papers, they were unable to help us.

This Committee wishes that this Report contained more valuable information. However, we believe this could hardly be expected when one realizes the short time we had in which to complete the work.

The full Report of the Committee will be found attached. It will be noted that the list has been prepared having regard to the populations served, to enable comparisons to be made as to the practices of the different companies in respect to the questions that were asked. Of course, in making these comparisons due consideration should be given to the class of competition given the different companies.

For the purpose of discussion, the following comments on the answers received to the various questions have been prepared.

Geographical Location of Our 45 Member Companies.

Ontario	27
Quebec	10
British Columbia	3
Nova Scotia	3
Saskatchewan	2

Population.

It will be noted that thirty-two member companies are serving territories populated as follows:—

12	5,000 and under.
6	Over 5,000 and up to 10,000
5	Over 10,000 and up to 30,000
2	Over 30,000 and up to 50,000
3	Over 50,000 and up to 100,000
4	100,000 and over.

Have You Electric Competition?

Twenty of the companies have a monopoly in their territories, as far as another supply of current for electric light and power requirements are concerned.

Six have as competitors, private owned electric light and power companies, four municipal operated plants, and two have both. It will be noted that five of the companies having municipal competition are in Ontario, and the other at Montreal.

Have You Gas Competition?

Sixteen companies are without gas competition. Gas companies are operated by seven other companies in connection with their electric light and power business. Six are in competition with artificial gas companies, two with natural gas companies, and one company at Hamilton has competition from a natural gas as well as an artificial gas company.

Do You Maintain a Separate Department to Secure New Business?

The majority of the member companies of this Association are serving territories of 10,000 people or less, and yet we find of the twenty-eight replies to this question, ten are maintaining separate departments. The North Bay Light, Heat and Power Company, Limited, of North Bay, Ontario, serving 9,000 people without electric or gas competition, has a separate department, no doubt making interesting increases in the revenue of the company by such wide-awake methods.

How Many Persons Have You Actively Engaged in Soliciting Business?

It is interesting to note that eighteen companies have one or more persons actively engaged in soliciting business. The others, no doubt,

leave the soliciting of business to their regular office employees. The table shows that the great majority of the solicitors canvass for all the different branches of the business.

How Paid? Salary or Commission, or Both?

Fourteen of the companies pay straight salary; the other four pay on a combined salary and commission basis. The salary system is the most popular and preferable, and yet there are some good points to be said in favor of the combination scheme.

Do You Maintain a Display or Demonstration Room to Interest Customers in Electrical Appliances?

Of the thirty-one companies who co-operated in the preparing of this Report, twenty have either a display or demonstration room. Four of the other eleven did not explain the reason they did not maintain such a department, but the other companies gave the following reasons:

One had very few lighting customers.
Three left this business to the electrical contractors.
Two did not consider such a department necessary.
One will open such a department in their new building.

What Appliances Do You Send Out on Trial?

Twenty-seven companies replied to this question and twenty send out appliances on trial. This Committee, believing it would be of interest to the Association, would like to hear from any member company in the room who do not send out appliances, the reason for their not encouraging such current consuming apparatus.

Do You Accept Payment for Electrical Appliances in Instalments?

Ten of the twenty-nine companies who replied to this question require the customer to pay upon delivery of the article. The other companies, anxious to have such appliances on their lines, are satisfied to receive payment in weekly or monthly instalments.

Do You Advertise?

It would appear that electric light and power companies are realizing that, to be successful in their business as well as in any other, advertising should be conducted, as we find that twenty-three of our thirty-one companies advertise. The mediums used are not uniform, however, the newspaper is the most popular and this Committee is glad to note that a majority of the companies who advertise have an electric sign.

Do Commercial Lighting Customers Pay for First Set of Carbon Lamps?

While this Committee realizes that the rates charged in any community affect this particular question and the three following ones, we thought in asking for this information that it might prove of interest and value to some of the members.

Seven of the companies supply the first set of carbon lamps free.

Do you Renew Carbon Lamps Free to Commercial Lighting Customers?

Eleven companies renew carbon lamps when they are returned burned out, free of charge.

Do Domestic Lighting Customers Pay for First Set of Carbon Lamps?

An additional company supplies the first set of carbon lamps free in the case of commercial lighting customers, making eight companies supplying the first set of carbon lamps free to domestic or residence lighting customers.

Do You Renew Carbon Lamps Free to Domestic Lighting Customers?

Thirteen companies renew carbon lamps free to domestic lighting customers.

Are Customers Required to Call at Office to Renew Lamps?

In these days when we say that we are not selling so many k.w. hours but "electric service," it is of considerable interest to know just what the different companies are doing in this connection, and from our replies we find that six out of the thirty companies that answered this question have a lamp delivery system. This Committee would like to hear the views of members present regarding this question.

Does Your Company Do Inside Wiring?

This question is perhaps of most interest to small towns without the service of an active electrical contractor, and yet we note some companies serving comparatively large communities that do inside wiring. It would be of interest to hear from some large and small companies why they do this work instead of leaving it to the electrical contractor in their town.

From our replies we note sixteen companies do inside wiring.

Two of the sixteen companies do inside wiring through the electrical contractor; these two companies being the Ottawa Electric Company, of Ottawa, and the Trenton Electric and Water Company, of Trenton, Ontario. Under this arrangement the work is secured by the company and turned over to the contractor. The company pays the contractor within thirty days after the work is completed, and the customer pays the company in weekly or monthly instalments, generally spread over one year. This plan is fully explained by the Chairman of this Committee in his paper entitled "New Business," presented at this Convention.

Thirteen of the companies who do inside wiring accept payment in instalments.

Does Your Company Sell Electric Light Fixtures?

The same remarks apply to this question as to the reason that the different companies do not leave the inside wiring business to the electrical contractor.

We find, by referring to the table, that seventeen companies sell electric light fixtures and twelve accept payment in instalments.

Does Your Company Sell Electric Motors?

We believe the reason so many companies sell motors is because the agent of the motor manufacturer makes few visits to the locality of the power company, which is a very good reason indeed.

We find nineteen companies selling electric motors, and fifteen of these are so keen after power business that they are prepared to accept payment in instalments.

Do You Supply Tungsten Lamps to Customers on a Rental and Maintenance Proposition?

Only four out of the thirty companies have such a proposition.

One of these companies is the one at Hamilton, and as this proposition is fully explained in the paper entitled ''New Business,'' presented at this Convention, we will not repeat it here.

From the experience of the Hamilton company it has been found to be an excellent business getter and retainer, especially where there is electric and keen artificial gas competition.

If You Have No Objection to Your Light and Power Rates Being Published, Kindly Attach Copies of Your Rate Schedules and Contracts.

When these questins were sent out the Chairman did not understand that this matter was being handled by the Committee on Rates and Contracts, but as we have since learned this no comments are being offered here on this subject, as we believe the matter can best be discussed when their report is presented.

Would Appreciate Receiving Data Regarding Any Scheme You Have of Securing Business.

Eight of the companies told of some of their business-getting schemes.

The Ottawa Electric Company told of ''the wiring of houses on the instalment proposition,'' and a similar proposition re electric signs. These schemes and others mentioned by the Hamilton Electric Light and Power Company, Limited, are covered in the paper entitled ''New Business.''

The replies of the other six companies were as follows:—

The North Bay Light, Heat & Power Co., Limited, North Bay, Ont.—

''We have a map with pins representing every house in town. Pins have silk colored heads. All busy pins are red; all dead pins other colors which classify houses and indicate whether wired or not. This map is kept up-to-date and is useful in getting at a glance where we are not doing business. Every week we record new houses built and represent them by new pins on the map. It's a stimulator. Of course, we

have a card system recording the houses individually, and whatever heating goods or other apparatus they have in use.''

The Richmond County Electric Company, Richmond, Quebec—

''Watch the building of new houses and canvass as found advisable.''

The Sarnia Gas & Electric Co., Limited, Sarnia, Ont.—

''Have been supplied plates for picture shows free by Iron (Electric) people and have had them used quite often at moving picture shows here.''

The Trenton Electric & Water Company, of Trenton, Ont.—

''We are arranging with the electric contractor to quote us a price per outlet; we, in return, deal with the customer and extend payment for six or twelve months, with interest.

''We pay the contractor in thirty days.''

The Watrous Electric Light, Power & Traction Co., Ltd., Watrous, Sask.—

''Our best asset for new business seems to be a voltage kept constant at 2 per cent. over lamp voltage and a steady, prompt and efficient service.''

The Western Canada Power Company, Limited, of Vancouver, B.C.—

''We are following the practice of some of the older central stations in this regard, except that we specialize on industrial power and particularly in the sawmill industry, where we are making exhaustive tests to determine the ratio between the average power used and the maximum power used, as well as the unit cost for the various products of the mill. We are finding this of very great assistance to us in breaking into the sawmill business which has heretofore been considered by contral stations almost undebatable ground. Notwithstanding the arguments advanced by sawmill owners that electricity cannot compete with steam, for the reason that the fuel costs them nothing, we have successfully demonstrated in a number of instances the fallacy of this argument. The waste of the mill, including the sawdust, slabs and cullings, all have a market value which is becoming very pronounced from year to year. Where we have a prospective customer whose factory or mill is driven by steam we make every effort to be permitted to go into the premises for the purpose of making tests to determine what the unit of cost is on each class of production. Sometimes these tests occupy the attention of an engineer and helper for three or four weeks' time. With the data thus obtained we are enabled to make comparisons as between the cost of electric and steam drive, and in many instances we have succeeded in putting in a single trial motor to demonstrate and prove some point in the favor of electric drive, and our success in this regard usually

leads up to installing of more motors a little later on, and gradually we are able to secure the entire drive. In this way we have just succeeded in replacing some 1,500 horse-power steam drive by motors in one of the largest sawmills in British Columbia.''

In closing this Report your Committee would request, providing it is the wish of the President and that time allowance has been made, that a thorough discussion be given to this Report, and that the experiences of member companies in regard to different phases of the commercial department of electric light and power companies that we have attempted to cover in this report, be heard.

We would like to see the work of this Committee continued, and we believe the discussion of this Report will be of immense assistance to the next committee in regard to what lines to follow.

Respectfully submitted,

T. F. Kelly (Chairman),
P. H. Kemble,
R. B. Snider,
W. H. McIntyre,
W. L. Adams,

Commercial Committee.

Mr. R. B. McDunnough: Mr. Chairman, in regard to the question as to why some of the smaller companies do inside wiring, I may say we were forced into this because in the Town of Three Rivers no contractors were liable and in order to protect our consumers we were obliged to do their wiring. There is another thing in regard to the Tungsten lamps and free maintenance. We are operating under an old charter in our town, and we are obliged to give a flat rate when demanded, and I think without question it is impossible to control it. Visitors in our city remark on the number of lamps burning in broad daylight.

Mr. Kemble: In regard to that question I would say that since we discontinued the wiring for customers the contractors have got together and have formed an association, and have established a series of prices per outlet, the schedule being of the simplest kind, having two variables, one for hardwood flooring and one for double wood flooring. The contractors have agreed to abide by that schedule. It may be of interest to some of you to know that the best price per outlet is $2, subject to a $1 increase if the outlets involve hardwood flooring, and also $1 increase for outlets where there is double pine flooring. That does not mean $4; it means a maximum of $3 per outlet. The service charge, covering the stand pipe, panel board, etc., varies from $10 in a house not exceeding 30 outlets up to $20 in a house with 60 or 70 outlets. This gives the canvasser, with a normal amount of care and common sense, an opportunity to give a customer a price on the wiring right on the spot, and insures that there will be no hard feeling on the part of the contractor. In regard to the Tung-

sten lamp, I notice Mr. Kelly has not put anything down here about the practice of selling Tungsten lamps, or the price at which they should be sold to the customers. I should be very glad to hear something from other companies on that subject. I am afraid I disagree slightly with Mr. Dunnough on the policy of Tungsten lamps for flat rate customers. I am inclined to think that, where the lamps are so situated in a commercial proposition as to be reasonably free from mechanical damage, if you are forced to give a flat rate it would stand looking into, and possibly it would be very advisable to put in a Tungsten lamp and let the company profit by the saving of current, particularly where it is a 100 watt lamp which can be relied on for a life of 1,200 or 1,300 hours right through.

Mr. J. G. Henninger: The Cleveland Electric Illuminating Company has adopted a little scheme that I think may be of interest. The contractors have got together and a schedule of costs for different classes and sizes of wiring jobs had been laid down in a manner similar to that just mentioned by Mr. Kemble. The soliciting force of the company then, as it gets its jobs, distributes them amongst the contractors. The method of distributing is as follows: Each contractor has been persuaded to look for business instead of waiting until it comes in to him. He is allowed a commission for each new house wiring application which he turns in. In addition to this the soliciting force distributes the jobs, which they get, among the contractors in proportion to the number of jobs which these individuals have turned in. In other words, the man who turns in 25 per cent. of the jobs gets 25 per cent. of the distribution from the company, and so on. This plan has resulted in harmony between the contractors and the illuminating company. Of course there are always some contractors who will not cooperate.

Mr. Kemble: I should like to ask the previous speaker if the contracts are distributed alphabetically to the contractors how he gets over taking away a job from the next man on the list in order to give it to the man who has brought in the extra contract. I should think that would be liable to cause some friction.

Mr. Henninger: There is a little danger of that coming in, but that alphabetical provision is put in to start the ball rolling, and after that has been started they hand out the jobs proportionately.

Mr. Kemble: Has that not caused friction?

Mr. Henninger: They have managed to get around that. You can see instead of holding the jobs up they proportion them out. If they hung up jobs they would have ''kicking,'' for the reason that the wiring would not be done quickly enough. The contractors are all like one big happy family when a little diplomacy is used.

Mr. J. H. Larmouth: I think the size of the town has something to do with whether the operating companies should do the wiring or not. You can almost take it as a maxim, the smaller the town the less ambition on the part of the local wire men, and it is really absolutely necessary in a very small place, in my opinion, for the operating company to do the house wiring in order to get all the business there is to be had in the town. The

local wire men will, to a certain extent, work as long as he is making wages. There is very little opportunity for him to spend money in that town and he just takes what work is coming and does not try for anything better. That has been the experience in the towns where I have been operating, and it certainly adds to a company's revenue to handle the local wiring along the lines outlined in some of the schemes which have been enumerated here, especially where the wiring is done almost at cost and the householder is allowed to pay for it on the instalment plan. In that case it works out very well, indeed.

Mr. McDunnough: There is a point I would like to bring up with reference to cheap incandescent lamps. In our town every hardware store and every grocery store keeps electric lamps in stock. They buy them up at 7 cents and sell them out to the consumers, and they do not use our lamps. In order to overcome that we have in the last two months been selling our electric lamps at the absolute cost to us, and we find by that we are getting back our business in the lamps and keeping our customers supplied with good lamps.

Mr. Maclachlan: I might say that in the Town of Belleville we have about 11,000 population, and we have practically the same conditions existing there, as far as the contractors are concerned, as Mr. Kemble was speaking of in Toronto. They did not form the association, however. We brought them together, but they are working on exactly the same plan, and it is working well at the present time.

There is one question I would like to ask with regard to the fire underwriters' inspection. Is it being lived up to in all towns, is it affecting the new business, and who pays the inspection fees? Another question I should like to ask is if any of the companies have any experience in the canning factory business. In our district some canning factories are going up due to the amalgamation of the Dominion Canners, and I would like to know if they have found any use for electric motive power in the canning factory?

The President: I would like to say this in connection with Mr. McDunnough's remarks in regard to the selling of lamps. I am strongly of the opinion, as no doubt you all are, that the company supplying the power and responsible for the quality of the light, should have some control over the lighting appliances and the lamps, and the only way to get that control is to sell the lamps so cheap as to prevent the sale of them by other concerns. This may involve a direct loss, but indirectly it is going to result in benefit to the company, by insuring a uniformly good product.

Mr. Kelly (closing discussion): Mr. Chairman, the proposition that the gentleman from Three Rivers is up against as regards inside wiring is difficult. The question in regard to maintaining the Tungsten lamps on a flat rate, Mr. Kemble answered. Mr. Maclachlan spoke about power being used in canning factories. At St. Catharines where one of our subsidiary Companies operate, there is a branch factory of the Dominion Canners, Limited. That canning factory is operated electrically, and I will be only too pleased to get data and send it to Mr. Maclachlan if he reminds me of it. In Hamilton there is a canning factory which is partially operated by

electric drive. The arrangement regarding having the inside wiring done by all contractors at an arranged price that Mr. Kemble and Mr. Maclachlan have spoken of, and also Mr. Henninger, is certainly the ideal way of getting around it for the central stations. The thing is to get the contractors to co-operate and do the work at a price that is satisfactory to everybody. Regarding the selling price of Tungsten lamps, in Hamilton it has been our practice to make a small profit on the sale of the lamp. I do not know if that is the practice in other places, although I have made comparisons of the selling prices of Tungsten lamps in Toronto and Ottawa and we practically stand the same.

Mr. Pratt: I would like to ask if any company furnishing Tungsten lamps on the rental and maintenance proposition has had any trouble with the customers removing the lamps and using them in other parts of the building, or if they have had any experience with the lock socket to prevent that?

Mr. Larmouth: With regard to the lock socket I had some experience with that in Peterboro some years ago, and we had trouble in some of the places. We tried several of them out and never seemed to be able to find any that were affected. The manufacturers did not seem to be able to make a socket that would hold the lamp and that you couldn't get out. There was one with a small key put inside the socket to turn it, but anybody could make one of those keys out of a piece of galvanized iron, or something of that sort.

The President: A suggestion has been made regarding Mr. Black, of Toronto, an old and valued member of this Association. Mr. Black, as many of you know, was obliged to abandon his work and to go to Europe in search of health. He has been many months over there under very discouraging circumstances, but I understand that some time ago a change took place and he is now on the way to recovery. It has been suggested that it would be a graceful compliment on the part of this Association to Mr. Black, who has rendered it so many services, if we were to instruct the Secretary to send a cablegram of greeting from this meeting.

The suggestion met with the hearty approval of the members, and the Secretary was accordingly instructed to send the message.

Colonel Street announced that a number of the ladies of Ottawa were present and would take the lady visitors to visit the Parliament Buildings, the Senate, the House of Commons, the Parliamentary Library, the E. B. Eddy factory, and other places.

There being no further business the Convention adjourned until two o'clock p.m.

AFTERNOON SESSION.

At two o'clock p.m. the President called the meeting to order and asked Professor H. P. Barnes, D.Sc., F.R.S., of McGill University, Montreal, to give his paper on "The Influence of Ice on Water Power Development."

Dr. Barnes: Mr. Chairman and Gentlemen of the Canadian Electrical Association,—It is a great privilege and honor, indeed, to be invited to give

a paper before this Association. Some of you may know I have been studying ice now for seventeen years, especially ice conditions in the St. Lawrence, and I may say I have been waiting seventeen years for an invitation to address this Association, and since the invitation has come I feel very happy indeed.

The paper that I have prepared deals principally with ice and its influence on the deevlopment of our great water powers. As you know the water powers of Canada are to be a great strength in the future, and are to be developed to a very much greater extent than they have been in th past, and while in the past engineers have been content to allow ice to interfere with the continuous operation of plants, in the future that cannot be so. As the public utilities depend more and more on continuous operation it becomes absolutely more and more necessary not to have stoppages.

THE INFLUENCE OF ICE ON WATER POWER DEVELOPMENT

H. T. Barnes, D.Sc., F.R.S.

Macdonald Professor of Physics, McGill University, Montreal.

(To be Illustrated with Lantern Slides.)

The industrial development of our vast water powers is of great interest to everyone looking to the future. As public utilities become more and more dependent on hydraulic power, the question of continuous operation is of far-reaching importance. Chief among the causes which affect uninterrupted service is the presence of ice, which for five months of the year forms in the water. Hitherto it has generally been accepted that disturbances from ice inevitably occur, bringing about temporary "shut-downs." It has been thought necessary in every well-designed plant to instal an auxiliary steam plant to carry the load, and so far as the public is concerned, little is known outside the power house. It cannot be said that this is desirable, and in the future big developments it will be too costly. That it is not necessary it is my desire to point out in the present paper. The matter is creating not a little interest among engineers who have had personal experience of ice troubles, and the public generally are beginning to awaken to the fact that inconvenience from the stoppage of the power is not to be allowed. During the days of small developments it was a matter of little importance; but in the near future an abundance of cheap power will become available that must not be subject to the caprice of Nature. Continuous service must be preserved if the confidence of the public is to be gained, and the wealth of power around us utilized to its full capacity. Canada has a great inheritance in its water powers. She is also blest with a vigorous winter, so that a study of ice conditions is of increasing importance.

Nowhere can one find a more wonderful example of the delicate poising of the forces of Nature than in one of our Northern rivers. As soon as winter sets in, the water cools to the freezing point, and varies but a few hundredths of a degree for the entire period of ice production. The reason is to be found in the particular nature of the freezing process. Every liquid which produces a crystalline solid has a definite freezing and melting temperature, which we are told never varies. The process of change involves a heat transfer without temperature change. We know, however, by the second law of thermodynamics that heat cannot pass from one body to another without a temperature difference. The latent heat of water cannot pass out without a temperature gradient be it ever so small. In the case of water the molecules give up their heat readily when changing to ice, and the change proceeds rapidly when the

temperature difference is only a small fraction of a degree. The microthermometer has revealed the magnitude of these temperature differences which have escaped detection in the reading of the ordinary thermometer. Thus when ice is forming rapidly, the temperature is found to be of the order of a hundredth of a degree below the freezing temperature, and the heat flows out of the molecules to keep the water from going lower. Similarly, when ice is melting rapidly, the temperature rises slightly. As a rule, ice forms, and that which is already formed, grows when the temperature is only a few thousandths of a degree lower than 32° F. Water can crystallize at a certain rate. When the heat loss is rapid, the temperature falls, thereby accelerating the ice production and preventing too rapid a growth. Similarly, ice can melt only at a certain rate, and the rapid supply of heat results in a slight rise of temperature in the water which accelerates the melting. A mixture of ice and water is at the true freezing point only when it is neither gaining nor losing heat. Rapid freezing or melting results in a temperature slightly lower or higher than this. Hence we find the balance in Nature continually swaying one way or the other, depending on the outside conditions.

It is doubtful whether the ice itself wetted on the surface ever differs from the true freezing point, since the surface of the crystal emits or parts with the latent heat, and is thus continually surrounded by a source or sink for the heat produced. The birth of an ice crystal takes place by the disturbing influence of foreign matter in the water such as fine particles of denudated material and by the direct action of cold air churning up the surface into spray which falls back frozen. The vapour from open water also furnishes the nucleus for the ice crystal, and the beautiful ice flowers noticed on a very cold day on thin ice are caused by the freezing of these particles. The steam noticed on a cold day from open water is a direct sign of the comparative warmth of the water, and must supply a vast number of small crystals which fall back into the current.

There are three distinct forms of ice met with in Nature: these are, surface ice, frazil ice and anchor—or ground—ice. Of these, frazil ice is the most troublesome to power houses, and causes probably all the "shut-downs." I will briefly describe these forms.

Surface Ice.

Wherever water is still, ice forms rapidly over the surface and closes it in. This ice starts in two ways, depending on the general weather conditions. It may spread over the surface quietly, commencing from the shore and working outward, forming a sheet that is smooth and often clear, but it forms more often from the freezing of the frazil and scum ice blown by the cold wind into the bays or inlets. In this case the ice grows backwards against the wind, being increased by the fresh accumulations. This surface layer is rough and opaque, and consists of large and small pieces with the crystal pointing in every direction. While the first method of freezing requires absolutely quiet conditions, the

second will often proceed over the surface of quite a rapid current. In both cases the water must be at the freezing point; and the heat carried off by the cold air. The effect of a wind is to increase very much the heat loss, and, therefore, the second method is the one which causes the more rapid freezing. Evaporation from the surface furnishes a large part of the heat loss due to the high latent heat of vaporization. Hence a wind from the north with little moisture in it will produce more evaporation and a greater ice production than one of the same temperature from the east or south. But, as a rule, a north wind is accompanied by fair weather, and sunshine inhibits the ice production to an enormous extent. An east wind with clouds and snow often causes vast numbers of crystal nuclei in the water.

As soon as the first ice layer forms, by whichever method, the wind is shut off from the surface, and scum ice is no longer formed. The ice sheet now grows rapidly in thickness by the conduction of heat through the ice to the cold air above. The rate of growth of ice may be calculated from ordinary data of heat conduction. The velocity of the wind and the rate of evaporation of the ice surface also determines the rate of growth. Presumably the water under the ice is at 32° F. and layer after layer of ice is frozen on. The ice thus produced is of great purity, since the freezing proceeds so gradually that air and frozen matter are readily expelled. It is always possible to tell this ice from the first layers, as it is clear and hard. The crystals are all grown with the main axis at right angles to the surface. Hence when the surface becomes rotten in the spring, the ice often consists of a lot of vertical needles standing on end. A wind or current will topple these over, and they quickly melt, giving rise to the tradition that surface ice sinks in the spring. Surface ice grows more and more slowly as the thickness increases, until it finally becomes stationary. It then proceeds to melt and decreases in thickness until the warm sun of April rots it away.

There is a limiting thickness to the surface ice which is determined by the temperature of the water under the ice. In our rivers the water gently flowing along the under surface of the ice is seldom exactly at the freezing point. This is due not only to the natural heat of the river bottom, which is entrapped in the water flowing over it, but also to the increasing power of the sun in the late winter months. The limiting thickness of the ice is due to this, and the decrease towards spring to the rising water temperature. The average water temperature under the ice is about 1/100th of a degree as shown by the microthermometer. In cases where under-currents are brought to the surface, we find what are called air-holes in a lake or river otherwise frozen over. This is due to the higher temperature at these places which prevents the ice from growing, and rapidly melts any surface layer formed at the outset of cold weather.

Surface ice, when it can be induced to grow, is a protection to the water, and prevents scum and frazil ice, but it also holds the water temperature back long into the spring, turning back the greater part of

the sun's heat. Water running under surface ice faster than half a mile per hour, will carry with it floating ice. Attention must be directed to this whenever an intake is situated in open water. Surface ice may also prove to be a menace and a continual source of trouble, as will be better understood when frazil ice is described.

Frazil Ice.

Frazil, as its name implies, is cinder-ice, so-called by the French from its resemblance to cinders or ashes. It is the fine needle ice found floating in the open water, and varies in size from minute crystals to large agglomerated masses. It is formed by surface cooling in water flowing too swiftly for surface ice to form. An estimate of the number of these crystals in a cubic foot of water shows on an average cold day in winter about a quarter of a million, but I have found it often reaches several millions. The current carries these crystals downwards and under the barrier of surface ice which extends over the quieter parts of a river, and there they settle upwards and become attached to the under side of the surface sheet. In a short time immense hanging dams are produced which impede the water course and cause a rise of the water level. During cold weather the under passages may become blocked entirely and a rapid rise of water produced above the dam. When sufficient head of water is gained, the whole ice jam is forced out and a winter "shove" produced. At some parts of the river, like the St. Lawrence, there is a continual rise and fall of water level going on all winter. This frequently interferes with the normal head of a power house and causes serious trouble.

During the period of rapid formation of frazil ice, the water is slightly below the freezing point, and, in consequence, the crystals are growing rapidly. They readily freeze and form agglomerated masses, and they attach themselves to objects immersed in the water which are likewise cooled slightly below the freezing point. The time during which supercooling takes place does not last very long, and is quickly relieved during the periods of fine sunny weather.

Anchor Ice.

Whenever a river is open in winter, the presence of ice growing on the surface of objects immersed in the water is observed. This ice forms in long needle crystals attached in the same manner as the ice flowers. As the ice thickens, the crystals become large, and finally form masses many feet thick of coarse-grained crystals. Anchor ice forms primarily from the cooling of the river by radiation. Water is an almost perfect absorber of heat, and, likewise, it is an almost perfect radiator. During the intense radiation at night in winter when the sky is clear and the air almost devoid of water vapour, the water and objects in it become supercooled. Ice forms rapidly and covers the entire river bottom. During the day the effect of the sun is to raise the water temperature slightly, and the ice soon loosens and rises to the surface.

Anchor ice plays little part in power house troubles, for during the period of frazil sticking, the anchor ice is frozen to the bottom and held in place. In fact, it appears to remove many of the frazil crystals in as much as it is growing rapidly and readily causes an adhesion of the fine needle crystals.

Power House Location.

A power house may be situated at a rapid or fall where the water normally freezes over for many miles above. As soon as the winter ice is formed, usually no trouble from ice need be feared. Until the river closes in, however, a period of frazil production may result and consequent closing down of the plant.

Sometimes open water conditions above compel a long forebay to be constructed where the surface ice is allowed to form. If the forebay is fed from open water, frazil jams are sure to occur, and the free waterway reduced or stopped altogether. It is better to run a canal up to the position of permanent surface ice to avoid this. When jams occur, little can be done beyond blowing up the ice by dynamite and blasting out a clear channel. In this case men must be stationed to remove the frazil from the channel, as the ice is drawn in by the current. When a forebay is fed from open water, it is better to keep it from freezing and handle the ice at the power house.

Ice troubles at the power house show themselves in the freezing of the racks, gates and turbine wheels. Special heating devices must be provided to avoid the sticking and freezing of the frazil crystals. The racks must be protected from the direct action of the cold air by a curtain wall, and may to advantage be heated. The iron bars of the rack when exposed draw the heat from the water and cause an abundant supply of anchor ice even when the water is not supercooled. By enclosing the racks, the natural heat of the water has full effect, and usually nothing more is needed to keep them free of ice.

When a power house is fed from open water, at times frazil may come down in such quantities as to stop the racks mechanically. In such a case the ice can be removed mechanically. Revolving racks would be of great service under such circumstances. For the turbines and gates steam-heat may be used, as in Mr. John Murphy's appliances. It is only necessary to keep the surface of the machinery a very small fraction of a degree above the freezing point, and this can be done easily. Mr. Murphy, who has already read a paper before this Association on ice troubles, has been wonderfully successful, and a visit to the Ottawa and Hull Power Company will show the practicability of his apparatus. Repeatedly the stations equipped with his units have been running when neighbouring stations not so equipped have been shut down with not a wheel turning.

The tail race sometimes causes trouble when the ice jams below and causes the level to rise. This is the most difficult to deal with. It involves dealing with the channel below, which is often too costly for a

small development. By maintaining an open channel below, trouble of this kind can be avoided. In general we can give some rules for avoiding ice troubles:—

1. Have covered racks and steam-heat provided for the trouble which always comes to a power house before the permanent ice forms.

2. Instal a few meteorological instruments to watch the weather in order to be prepared for the first cold snap.

3 Where the forebay is fed from a lake or canal, induce freezing as soon as possible: otherwise maintain an open channel down to the power house. Provide a special way for the floating frazil.

4. Watch the temperature of the winter at the outset of cold weather, and when 32° F. is approached, have the steam-heating plant in readiness.

After the reading of the paper, Dr. Barnes had some pictures thrown on the screen illustrating the different points in his paper.

The first slide illustrated the three kinds of ice spoken of, surface ice, anchor ice and frazil ice. Dr. Barnes explained the formation of the crystals of ice, called frazil ice, which were carried by the water under the surface ice and where the current was very slow rose and stuck to the underside of the surface sheet, thus checking the flow of the river and cutting off the water supply. This ice was what caused most of the trouble in power works. Dr. Barnes thought a distinction should be made between frazil ice and anchor ice, as there was liable to be confusion. The frazil ice crystals, said Dr. Barnes, were most important, because they were formed in open water, and on an average cold day in winter there were about a quarter of a million of these crystals per cubic foot, and sometimes the number was increased to several millions per cubic foot. When these crystals got into quieter water they attached themselves to the surface sheet and began to build downwards, and the only way in which these frazil crystals could be taken care of and rendered free from causing difficulty was to pass them on as quickly as possible. The anchor ice, he said, grew chiefly by radiation of heat, because the water was a great radiator and absorbed all the radiation that fell upon it from the sun. In the night time the water became cool and the ice grew on the bottom, and, being cooled with the water attached itself. This ice always stayed anchored to the bottom and did not move at all as long as the cold weather lasted or until the sun got up and the heat melted it off, and had nothing to do with the trouble in the power house. Surface ice might or might not be useful to a power house depending on the conditions of feeding. Surface ice turned aside the sun's rays and kept the water much colder long into the spring. Frazil ice sometimes stuck to the racks and wheels of power plants and caused trouble. While it was thought the temperature stood constantly at freezing point when ice formed, experiments with more accurate instruments showed that the temperature of water was subject to variation.

Dr. Barnes then showed a picture of the Lachine Rapids where experiments had been made with an electrical thermometer, and gave the results

on charts. If one started to melt ice it was found the temperature would rise above the freezing point and as the heat applied increased the temperature rose still more until all the ice was melted and then the temperature went up with great rapidity. This was all in very narrow limits and the ordinary thermometer would not show it at all. One would think the water was exactly 32 degrees, but by the use of the more accurate instruments very small differences were shown. When ice was melted rapidly with water present the temperature was a little bit above the freezing point, and it was exactly at 32 degrees only when there was a mixture of ice and water, neither gaining nor losing heat. The instant water began to freeze the temperature fell a little below 32. Dr. Barnes then showed some pictures illustrating experiments which had been carried on at the River Neva, in Russia, and also some experiments made on the vessel Lady Grey.

Dr. Barnes then showed a number of slides showing ice formations in different localities, showing how even a 100th of a degree below or above freezing would have an effect on the formation of ice.

In conclusion, Dr. Barnes explained how he had got the idea of telling by means of his thermometer the presence of bodies of ice in open water.

Mr. John Murphy: I will attempt to make a few disjointed remarks in connection with the ice question. Ottawa's first hydro-electric station started in 1882, 30 years ago. I was too small, of course, at that time to work in it. When I get started talking about the ice question it is pretty hard to stop me, but I do not intend to detain you very long. I mentioned to Mr. Larmonth that I was liable to tell all I had ever run across during these years, but he warned me that the Convention only lasted three days. I would like to illustrate a few points, chiefly in connection with the changes in temperature, and I will show you some views in connection with conductors of heat, heat insulators, and so on. During a great many years the services with which I was connected were put out of business by frazil ice, or anchor ice, as it was popularly called. We made a great many efforts to find out why it occurred. We knew very little about it, except that we were sure to have a shut down as soon as winter came along. In an attempt to find out something about it we made some records of the temperature of the water. In the fall, about the beginning of October, when we felt the shadow of the shut-down coming upon us we started to take the temperature of the water, and we found, of course, that the temperature of the water gradually fell 45 degrees to the end of October. The air, of course, varied very considerably, sometimes going considerably below the freezing point. Finally it fell down to freezing point, and on the 4th of December our plant was shut down. During the rest of the winter three times a day my men measured the temperature of the water, and three times a day during some four month they faithfully recorded 32 degrees Fahrenheit. About 1905, I was fortunate enough to pick up a paper written by Dr. Barnes, whom I did not know at that time. His paper was entitled ''Temperature Measurement and Ice Formation.'' In that paper there was a statement to the effect that the temperature of the water did not stay at the freezing point. This disturbed my confreres very much for we knew it stayed there. Had

we not some four hundred records in our log book to show that it stayed there? But he said, No, we were all wrong, it was not 32 all the year round nor all the winter, but sometimes is was 32.001, and sometimes it was 31.999. That, I may say, was a source of great satisfaction to myself and my confreres. After we had accomplished some wonderful results in ice-fighting a number of gentlemen connected with the Hydro-Electric industry, some hydraulic engineers and electrical engineers, were good enough to tell me that I didn't know anything about the business. They told me I did not appreciate what they were up against in attempting to overcome the wonderful force of nature in this climate, and that to attempt to combat these forces with anything made by the hand of man was ridiculous.

Mr. Murphy then had thrown on the canvas a number of slides showing ice formation that he had observed. One interesting picture showed the fire at the Equity Life Building in New York and how the ice had formed from the spray of the water. Another slide showed a rack covered with ice, and Mr. Murphy explained what had been done in some cases with heating the bars, thus overcoming to some extent the ice difficulty. A number of slides were shown in this connection. Mr. Murphy went on to say that notwithstanding what had already been done in this line it was very hard to convince the general public that anything could be done, and illustrated this by a story told of the Wright Brothers, the famous aeroplane men. They had three boys operating aeroplanes outside of Dayton, and an old resident came along as these boys were flying. Said the latter, with his eye on the machines in the air, "When I first heard you fellows were going to fly I did not believe it; later on I read you had been flying, but I said that it was a pack of lies." Then the old man with his eye still on the three aeroplanes in the air said, "And I would like to have you know I am not what you call convinced yet." (Laughter.)

Mr. Murphy then showed some pictures of power plants illustrating the different modes of construction. With concrete and steel construction the ice formed very much more quickly than with the old-fashioned wood construction. Another plant which had a steam heating device had never been frozen up, while those without the device had been. The picture showing the engine at the Equity Life Fire covered with ice showed that a great deal of heat might be employed to no purpose if an insulator was put in between. (Applause.)

The President: We have heard some very interesting remarks by the previous speakers, and Mr. Murphy has given us some conclusions he has drawn from his long experience in dealing with ice matters. I may say that while Mr. Murphy was taking care of the supplying of power for the company with which I am connected I knew that the matter was in good hands and I took only a very general interest in the matter. However, I came to the conclusion many years ago that iron bars were not the very best thing for racks, for the reasons which Mr. Murphy has given you; that they are good heat conductors, and, therefore, there must be a very rapid transference of heat when the upper parts of those bars are exposed to low temperature. I have been an

advocate of the housing of racks, especially since viewing some of the plants on the Niagara River. It seems to me that a large housing chamber which men can enter must be effective, because after all it is not necessary that the air in this chamber should be very warm. If you keep it about the same as the temperature of the water, then there is not much chance for conduction of heat along these bars. Mr. Murphy has stated the fact that the plants in this city, notwithstanding the experiments and conclusions he has come to, are still going on in the good old way. It is a big question and I do not want to go into it just now, except that I might say in fairness that ice is manufactured on the racks and it is also brought there in the water. In providing a rack with steam heating you must not place obstructions which will prevent the use of the tools which you have to employ to remove ice which is carried down stream.

Mr. W. L. Bird: Mr. Murphy reached practically the same conclusions as reached by myself at about the same time in Montreal, at the Lachine Rapids' plant. We were both much indebted to Dr. Barnes for his paper on Frazil Ice in 1902 and 1903, because of its practical application to the solution of power plant ice difficulties. Mr. Murphy's slides have shown you a great deal better than any discussion, some of the serious difficulties that were to be contended with and how they were overcome. At Lachine Rapids, at which some of Dr. Barnes earlier experiments were made regarding the formation of frazil ice, the method of overcoming the difficulty was somewhat different. The power house racks extended over a frontage of a thousand feet, exposed to the outer air, and the situation did not lend itself to the construction of a practical housing that would remain air-tight from year to year, and could be heated at a reasonable cost so as to be kept above 32° F. Determined efforts were made, however, to prevent circulation of cold air at the rear of the draft-tubes from the tailrace side of the power house, that could in any way conduct cold to the water-wheels. Similar precautions were taken to make the long power house as air-tight as possible: All the load possible was crowded on to this power house, at about the time the freeze up of the head ice was anticipated. This was supplemented by all available heaters, and nothing left to a chance, that would in any way permit the frazil gathering equipment to approach the critical temperature of 32° F.

As we could not arrive at a practical means of heating the racks, so far as its local application was concerned, we took the ''bull by the horns'' and lowered sufficient racks to prevent loss of head of the racks. This seemed somewhat of a risky procedure, apparently leaving the plant exposed to debris, and with a possibility of transferring the formation from the racks to the wheels. The rack frontage was protected by diverting booms to overflow sluices, of which there are three, through the power house. In the winter there is practically no floating refuse, and the racks were restored as early as possible in the spring, before any debris came down. Previous to the time referred to, serious trouble had

been met with, due to the frazil causing a dam at the racks, for which they were not designed and resulting in serious damage to wheel cases, and the shutting down of the plant from twelve to twenty hours regularly once each year at the time of the freeze up, owing to formation of frazil on both the racks and the wheel cases. The changes as noted above completely overcame this difficulty. The difficulties at the entrance to the intake due to the gathering of the frazil dam,, under the surface ice, with resultant loss of head, still remains more or less a source of trouble and loss of power.

In order to get rid of floating ice, it is necessary to have an open channel exit. The difficulty at many plants is to maintain such an open channel, where the floating frazil will be freely carried away and not allowed to choke up. Where open diverting channels were maintained diagonally across the head race, by which to sluice off the incoming frazil, it was found that the frazil beds would again rapidly form on the downstream side of such open channels, with further resultant loss of head. These beds of frazil ice have been measured to a depth of twenty-eight feet, which to those not familiar with the conditions would hardly seem possible.

This company, with others under similar circumstances, has tried every conceivable scheme that seemed to hold out any practical hope of improving their conditions and reducing their trouble, but so far such measures of relief have been of questionable commercial value.

The President: Mr. Murphy spoke of the man who would not be convinced. He was probably a brother of the man who had never seen a giraffe, and when he went to the Zoo and looked at it said, ''It isn't true.'' I believe neither Mr. Murphy nor any of us here—at least, I can speak for myself, would have believed it was possible to turn a little steam into a large body of rapidly flowing cold water and influence it in any appreciable manner, until Dr. Barnes' very valuable contribution showed us what a very little difference in temperature is necessary to determine whether ice is going to form or not. Dr. Barnes is doing a work of national importance. (Hear, hear.) His work is far from being completed, but even as far as it has gone, it stamps him a public benefactor. He is going to benefit trade and industry, and everyone in this country will derive some benefit, directly or indirectly, from his investigations.

Mr. W. H. Munro: Mr. Dion's last remark is very appropriate after listening to Dr. Barnes. He has presented a vast amount of information even in the short time he has spoken this afternoon, and Mr. Murphy has pointed out the application of some of his ideas. These are amongst the most pressing questions that hydro-electric plants are confronted with, ice on the racks and on the turbines. There is another difficulty to which Dr. Barnes' information will have to be applied sooner or later, and that is the effect of anchor ice sticking to the channels and backing up the tail water. In the Trent Canal territory there are parts of the stream on which there are practically no lakes and during the ice season the tail races of some plants are backed up anywhere from

two to ten feet, the heads being from eighteen feet to twenty feet. That is a condition which is going to put the plant out of business unless some means can be found to overcome it. I would like to ask Dr. Barnes if in regard to that matter of keeping the surface clear, he advocates that the surface of a stream of that kind flowing at a fairly low rate should be clear, or if it is clear will it help to overcome the difficulty?

Dr. Barnes: The Trent Canal forms the tail race, does it?

Mr. Munro: Yes. In one plant the tail water will be from two to ten feet above its normal level, and you can't see any decided drop anywhere in the river.

Dr. Barnes: Is it caused by frazil dams below?

Mr. Munro: It must be.

Dr. Barnes: The only cure for that is to keep an open channel below. It is only by maintaining an open channel below that trouble of this kind can be avoided. The question comes up in a great many power houses, and I do not think the maintaining of an open channel is a serious difficulty. In the power houses on the St. Lawrence the results were enormously greater than any man had any idea of when he started.

Mr. Munro: The first step towards that would be to clean out all the old piers and any shallow places in the river channel.

Dr. Barnes: Yes. What is the current?

Mr. Munro: Probably a mile and a half an hour, or two miles.

Dr. Barnes: The St. Lawrence will keep itself clear of ice running at a mile an hour if there are no obstructions.

Mr. Munro: Clear of anchor ice?

Dr. Barnes: The anchor ice will form, but it will flow along. The river freezes only by mechanical interruption, in, I think, three places.

Mr. McDunnough: I do not know that I can add much except in the way of a little personal experience. We had a plant on the Gattineau River, and I have seen our plant so frozen up with frazil ice that we couldn't get anything through, but that was early in the morning, say about half-past five, and then the frazil would disappear as if by magic. At Shawinigan they have built a curtain wall about ten feet in front of the rack going down about ten feet below the level, and they are heating this air electrically and they circulate it with fans driven by electric motors, and they had absolutely no trouble from frazil ice last winter. They had a little bit of trouble with floating ice which came down and blocked the racks, but they had plenty of space inside to throw it right out. They had some trouble also with ice forming in the penstock, but that was on account of the penstock not being protected. These penstocks will be covered up and then there will be no more trouble. Last year the ice formed and in the first few days the ice let go of the penstocks and came down on the wheel.

Mr. G. B. Smith: I do not think I can add very much to this discussion. In two power houses with which I am connected the racks are in three pieces, the two lower sections are iron and the upper wood. That has been partially effective, but it is is only partially so, because

there is no heat applied to the iron girders on which the racks are laid and the ice forms around the girders. In the other power house where the steel racks come right above the surface, they were blocked up two or three times, and I believe now it is the intention to supply steam in much the same way as has been described.

Mr. Kemble: I should like to ask Dr. Barnes whether he has formulated any limits of temperature to which or through which the racks, the penstocks or the wheel case has got to be raised to obviate the difficulty of the freezing; in other words, whether he has found any standard which can be applied to the calculation of the amount of heat required or whether it is a case of cut and try.

Dr. Barnes: All I can reply to that is that the lowest temperature that has been measured by my instruments for the water is six-thousands of a degree below the freezing point, and, therefore, that would be the upper limit to which you have to keep the racks. Keep the racks at freezing point and the ice will not stick to them. You would be safe on a hundredth of a degree. That would be an absolutely safe limit to work on.

H. C. F. Poste: We think we have had at Massena as varied an experience with ice troubles as is possible to get anywhere and of all the schemes we could devise to overcome them, there is one that has proved most successful.

Our headrace is a canal three miles long which will not freeze over under normal conditions. The past two years we have watched the water closely and when ice crystals are observed, shut off enough power to allow the formation of surface ice, which in a few hours will be of a thickness of about two inches. A good safe coating assured, we take on power again, and by maintaining a four or five-foot drop in the canal, we draw the river slush under the ice and through the wheels and have been able to carry a great deal more power than we could in any other way.

We ran across an interesting observation in finding quite large stones supported by ground ice that had lodged against the racks. Presumably these stones had been carried from the St. Lawrence under the canal ice. We have some misgivings as to the damage they might do our wheels were we to operate with part of our racks removed as has been suggested.

Mr. Pratt: I understood Dr. Barnes to say it was advisable to keep an open channel in your hear water. Does that apply in a case where you have large storage basins and there is very little current except the current due to the water flowing towards the penstocks?

Dr. Barnes: Where you can get a large enough storage basin let it freeze over as quickly as possible, but if it is open water, half a mile an hour will keep it clear. It takes very little current to carry floating ice under the surface.

The President: It only remains for me before closing the subject to thank Dr. Barnes on behalf of this Association. If there are any

points raised on which he would like to speak we would be glad to hear him.

Dr. Barnes: I think I have said enough. I am very much flattered, indeed, that you should have taken such interest in my paper. I again thank you very heartily for allowing me to talk on this matter. (Applause.)

The President: I think the boot is on the other foot. This Association is indebted to Dr. Barnes, and the appreciation of the paper has been shown by the applause.

Mr. Munro: I would like to ask Mr. Murphy a question. Does the frazile ice simply form by going through the rack which is a lower temperature than the water?

Dr. Barnes: The lower temperature forms it and the frazile sticks as it goes through.

Mr. Munro: Is it frazile ice that forms on the water wheel?

Dr. Barnes: If there is frazile ice in the water it will stick. The racks themselves will also form ice if there is no frazile in the water.

Mr. Munro: In case it is so thick it will go through the racks and block your water wheels?

Dr. Barnes: If it is allowed to stick there; but if it gets through the racks it will get through the wheels. It simply sticks to the wheels or it wouldn't stay there.

Mr. Munro: In case of any sudden drop of temperature it will freeze so thick that the water will become a porridge as it were, and go through and block everything. We found that in our experience.

Mr. Murphy: That is quite a common experience. The river right here at Ottawa becomes thick as porridge quite frequently, and when frazile forms in such large quantities it will stick to anything if the temperature of that thing is one ten thousandth degree below freezing point. The heating of the apparatus is for the purpose of preventing the frazile from adhering to anything. I tried to hammer in the point that these things were actual manufacturers of ice, and that frazile would stick to them. In a paper delivered by me seven years ago answers to Mr. Kemble's question will also be found, as well as answers to a number of others.

J. J. T. O'Donnell: As I understand it, Mr. Murphy claims that the application of a very moderate amount of heat, probably one hundredth of a degree as the theoretical amount, would only be necessary to keep the parts sufficiently warm to allow the frazile to slide right through the wheels. Of course the racks must necessarily be heated to the same temperature if a perfect operation is to be obtained.

Mr. Bird: Through his earlier researches at Lachine Rapids, Dr. Barnes has considerable knowledge of the local situation, and it would be both interesting and of immense value to that Company, if he could suggest a practical solution that would enable a plant, so situated, to carry its full load without loss of head.

Six years ago the speaker went West to take charge of a power plant at Fort William. Owing to the very cold and very long winters, with the thermometer ranging as low as 20 to 45 degrees below zera for days at a time, it was considered advisable to take extra precautions to avoid ice trouble. These precautions consisted in protecting every part of the conducting waterway from the racks to the tailrace, from the other atmosphere. The racks were covered with airtight covering, in addition to the outer intake baise, and the chamber back of the racks kept heated throughout the winter. The air vents and forebay were also supplemented with electric heaters. The panstacks were covered with a wooden basing, with a felt covering, and well banked, so as to make an absolutely dead air space. The draft tubes and turbines were inside the heated power house and, therefore, immune.

In six years' operation the Kaministiquia Power Company's plant, referred to above, have, without a single exception, been free from ice trouble of any kind, and without loss of head or capacity, at either the intake or the tailrace; surely a unique record, when compared with some Eastern plants that we know of. The plant is somewhat similar in design and conditions to that of the Ontario Power Company at Niagara Falls.

Mr. G. G. Gale: I should like to ask Dr. Barnes to what speed the water should be reduced to prevent the formation of frazile. We have same water above our power house and in this rapid frazile has formed. If we had reduced the velocity we might have stopped the formation of frazile.

Dr. Barnes: As long as there is open water there will be frazile. Of course, you can induce surface ice to form on water running up to two and a half miles an hour, but it has to be done carefully. With regard to Mr. Bird's question, the only answer is to keep the frazile moving. There is no use making airholes. You have to have a channel.

Mr. Bird: That is what they opened the channel for.

Dr. Barnes: I think the Lachine is hopeless at present.

Mr. Murphy. Mr. Gale's question tempts me to say one more word. Surface ice in my opinion is a good thing to form to prevent frazile formation. That view is held, I think, by a majority of the hydraulic engineers. In fact a great many of them have told me they will never have any trouble at their plants because they have built a dam.. They have done away with all rapids, and they have created a smooth lake above their plant. Now, as to the plant to which Mr. Gale referred, I think about twenty-five miles of smooth water may be obtained, but notwithstanding that fact frazile troubles make themselves felt quite frequently. At another plant I have in mind there are several storage reservoirs immediately above the plant, and then a stretch of quiet canal amounting to nearly twenty miles. This canal connects with a lake 200 miles long. The lake connects with two rivers about 80 miles long, and then another lake comes in 250 miles long. At the end of the upper lake there is a little rapid. The point I want to make is that

between the plant in question and the nearest rapid or rough water above there is a stretch of six hundred miles. Now, frazile ice forms at that plant, notwithstanding all this smooth water, as it is called. The point is, the water does not stay smooth. The wind roughens the surface and frazile instead of surface ice forms.

The President: If I may be permitted, I should like to ask if at the plant to which Mr. Gale refers, while there is a very long lake of still water, or slow running water, which is covered with ice in the winter time and, therefore, protected from wind and cold air, there is not, however, a small space of open water just above the racks?

Mr. Gale: Yes, a very small entrance above the Island.

The President: The question is whether frazile ice can form fast enough in that small space.

Mr. Murphy: In my opinion, I think the frazile undoubtedly comes from the lake in the early winter.

The President: I can understand that in the early winter the wind will have a great effect on the lake current, but when it is covered with ice there should not be any trouble.

Mr. Murphy: No, there should not.

At this point the Secretary read a telegram from W. L. Adams of Niagara Falls expressing regret at not being able to be present and bespeaking continued prosperity for the Association.

The President then asked Mr. J. G. Henninger, Illuminating Engineer, National Electric Lamp Association, to give his paper on "Recent Developments in Lamps and Reflectors."

RECENT DEVELOPMENTS IN LAMPS AND REFLECTORS

J. G. Henninger

Illuminating Engineer, National Electric Lamp Association.

The past year has been one in which the lighting industry has left its imprint on the pages of progress. In no sense has this progress been spectacular, but steady and sure. It was not long ago that commercial and industrial activities ceased at night-fall; social activities only went on. With the advent of gas, manufacturing and commerce began to crowd into the realms of night, and now with so many high efficiency electric illuminants available, the wheels of industry turn constantly from one week's end to the other.

Let us point out a few of the milestones in the growth of the electric lighting industry during the last 54 years.

1858—The first patent was granted in United States for an incandescent lamp having a platinum filament.

1870—Electric arc lighting was introduced.

1880—The Edison carbon lamp with flashed filament came into use, the Edison factory output being about 25,000 lamps during the year.

1885—The transformer was invented.

1887—The 3.1 w.p.c. lamp was brought out.

1893—The cellulose filament was produced.

1895—The chemical exhaust was practically used and made it possible to produce much longer-lived lamps.

1898—The Osmium lamp was brought out.

1903—The Gem, or Metallized, filament incandescent and the Nernst lamp made their appearance.

1906—The Tantalum lamp was brought out. The Illuminating Engineering Society was founded in January, 1906; and the New York ''Illuminating Engineer'' was first published during that year.

1907—The pressed filament Tungsten lamp was put out.

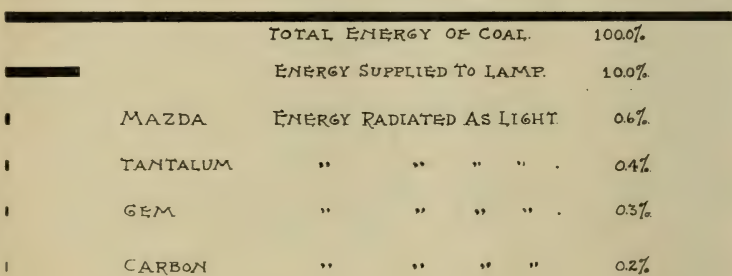
1910-1911—The drawn wire Tungsten filament lamps were put on the market.

The improvement of incandescent lamps since the time when they were first produced has been truly wonderful. Contrast the efficiency, life, and candle-power maintenance of the average incandescent lamps of to-day and that of those made during 1880. Where the carbon lamp of to-day will last for 800 hours and more, a lamp at that time would last scarcely

40 hours. Many of the first lamps burned out a few moments after current was first passed through them. These first lamps burned at an efficiency of about 7 watt-per-candle. The ordinary carbon lamp of to-day burns at an efficiency of 3.0 watts-per-candle and the metallized filament lamp burns at 2.5 watts-per-candle. The king of all incandescent lamps is the drawn wire filament lamp burning at a little over 1.0 watt-per-candle and giving an average life of easily 1,000 hours, while the average candle-power through life is easily 90% or more. The relative efficiency of the various incandescent lamps as energy transformers is shown graphically in Fig. 1.

Fig. 1.

RELATIVE EFFICIENCY OF INCANDESCENT LAMPS.



Not only have the incandescent lamps been brought up to a high state of perfection in every way, but they are made in sizes ranging all the way from the tiniest necktie lamp to the large 400 and 500 watt. Within this range can be found lamps suitable for practically every purpose. Within the past few months the 15 and 20 watt sizes have been added to the list of standard voltage multiple lamps.

In the automobile industry the use of the high efficiency lamp has increased wonderfully. A few years ago electric headlights on automobiles were almost unthought of, while to-day they are common. Drawn wire may be made up into coil filaments especially adapted for use with parabolic reflectors. Electric trouble lamps make it possible to inspect all parts of machines with "perfect safety." On a stormy night when troubles may come thick and fast a "trouble lamp" which will not blow out is appreciated.

During the past few months a dip or lacquer has been prepared so that when the bulb of the ordinary high efficiency lamp is coated with it, the light transmitted through the dip is practically equivalent

in quality to the light received from a clear north sky. The dip screens out the undesirable elements contained in the light rays emanating from the filament. The beauty of this scheme is that the size of the daylight units is limited only by the size of the incandescent lamp. This makes it possible for the smallest merchant to meet his requirements as readily as the largest concern. These lamps will find application in stores, paper mills, dye establishments, etc., where color matching is important.

Fig. 2—Corner of a press-room, showing daylight illumination of same.

The developments in the line of industrial lighting during the past few years have been wonderful. Just a few years ago the manufacturing establishments which did run after nightfall received their only illumination from oil lamps or from gas jets placed here and there.

Anyone who has had occasion to work under illumination provided by gas jets will realize how difficult it is to do good work with flickering illumination resulting from them. A few years later some general illumination was provided throughout shops by means of arc lamps, while each machine was provided with two or three incandescent lamps. These units were generally provided with wire guards so as to minimize

Fig. 3—Press room under artificial light.

the likelihood of breakage. The cords, however, were constantly getting in the way and tangled up with belts, pulleys, etc., and no end of trouble was experienced.

The brightness of the old gas jet or oil flame was between 3 and 8 candle-power per square inch, while the brightness of the carbon filament lamp was about 380 candle-power per square inch. It has been demonstrated both scientifically and by experience that any light source

having a greater brightness than 6 to 8 candle-power per square inch is trying on the eyes, hence it is not hard to imagine the difficulty with which the workmen were able to watch their work with a source of 380 candle-power per square inch brightness before their eyes. In order to protect their eyes many hung up paper shades or cut tin cans in two—anything to shade the light from the eyes. Around each machine

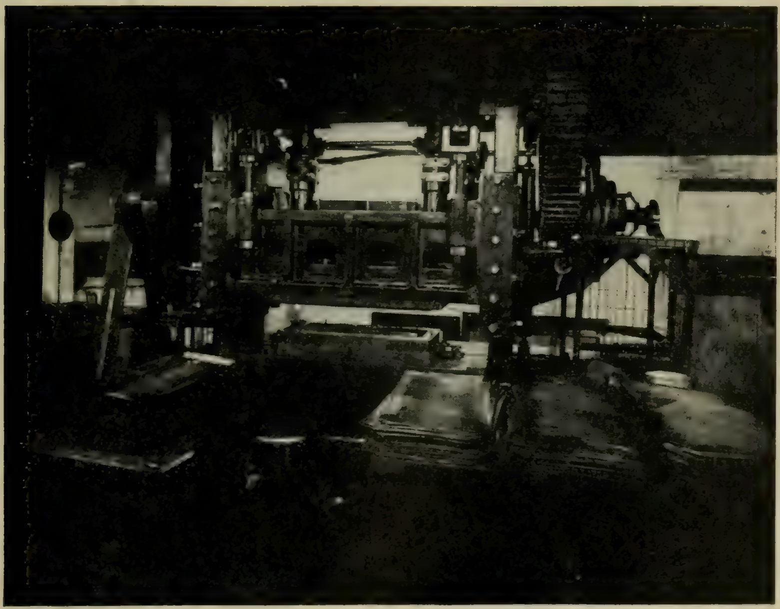


Fig. 4—Large press as it appears under Mazda light. Note detail of die.

was a little circle of light, but midway between, the area was comparatively dark. Such a condition could not be other than conducive to a large number of accidents as well as to eye strain and its attendant discomforts.

Manufacturers are beginning to realize that good lighting is absolutely essential to good and efficient production, and hence are beginning to go into the matter thoroughly and scientifically.

A long time ago it was realized that some form of reflector was necessary, not only to protect the eyes, but also to get a larger percentage of the light down on the work. To meet this requirement cone reflectors made from bright tin were first used. It was found that these reflectors threw a great many streaks on the work illuminated, so that in some cases the interior of the reflector was eventually covered with white enamel paint. In time, however, this paint would peel off, the reflector become rusty and the lamp covered with dirt so that

the combination as a whole was poor. Nevertheless, it was somewhat better than the bare lamp.

With the advent of the high efficiency lamp a few years ago general illumination of industrial plants by means of incandescent lamps was recognized as entirely practical. About the first reflector of any importance which appeared on the market was a radially fluted steel

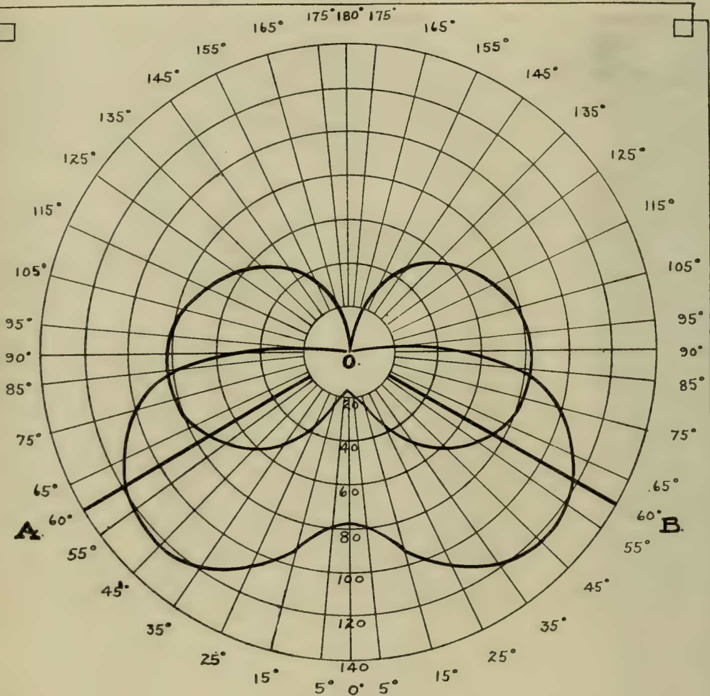


FIG. 5.

Total Flux of Lamp	In Lumens	857.0	= 100. %.
" " " In Upper Hemisphere	" "	417.0	= 48.6 ".
" " " " Lower	" "	440.0	= 51.4 ".
" " " " Angle A-O-B	" "	168.3	= 19.6 ".
Total " " " With Reflector	" "	683.3	= 79.6 ".
" " " " Ref. in Upper Hem.	"	30.8	= 36 ".
" " " " " " Lower " "	"	652.2	= 76.6 ".
" " " " " " Angle A-O-B "	"	365.2	= 42.6 ".

reflector coated with white porcelain enamel. This was followed shortly by dome or wide bowl-shaped reflectors, the inner surface of which was coated with white enamel. From that time up to the present, developments have been exceedingly rapid. Reflectors having a reflecting surface of aluminum paint have been used to a great extent, but I feel safe in saying that the present day practice in industrial plants is to

use enameled steel. It would be well to add, however, that there are many places in which glass reflectors of various types can be successfully used.

An improvement in the lighting of large industrial plants, especially large erecting floors, foundries, etc., has been brought out within the past year. A large enameled steel reflector for the 400 and 500 watt lamps has been produced. This reflector is so designed that the greater portion of the light from the lamp is confined within a vertical angle of possibly 120°, while the spread horizontally is not far from 180°.

ILLUSTRATING USE OF ANGLE REFLECTORS IN STEEL MILL ILLUMINATION.

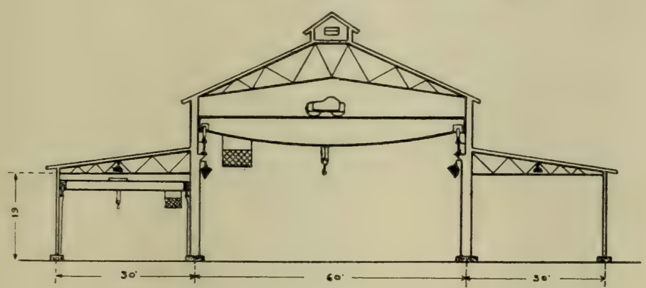


FIG. 6.

Maximum intensity is produced at an angle of about 45° below the horizontal. It has been found that a very efficient system of illumination can be had when these units are placed along the sides of a shop beneath the crane rails. This makes it possible to get the light source nearer to the floor and hence utilize light more effectively than can possibly be done if the units had to be hung above the crane. Of course such a system is not applicable in wide shops having a low ceiling, but in a plant where the floor is possibly 60 or 70 feet wide and the crane 35 or 40 feet above the floor, these units obviously offer a good solution to the lighting problem. Many plants have been lighted in this same manner before, using arc lamps. The difficulty, however, has been that a great deal of the light emitted by these arc lamps has been lost against the walls, while with the equipment just mentioned, this light is redirected out upon the floor.

Another noteworthy development in the line of industrial lighting has been a low voltage system of specific lighting. This system is especially applicable to shoe and clothing factories. With this system

a general illumination of moderate intensity is usually provided, while on each individual machine is placed a low candle-power, low voltage Mazda lamp fitted with a metal reflector. These units are very small and compact and may be fitted to practically any machine. Their design and their size is such that they do not get into the operator's way, and at the same time they concentrate the light just where it is needed. The accompanying photographs will show clearly how this system may be applied.

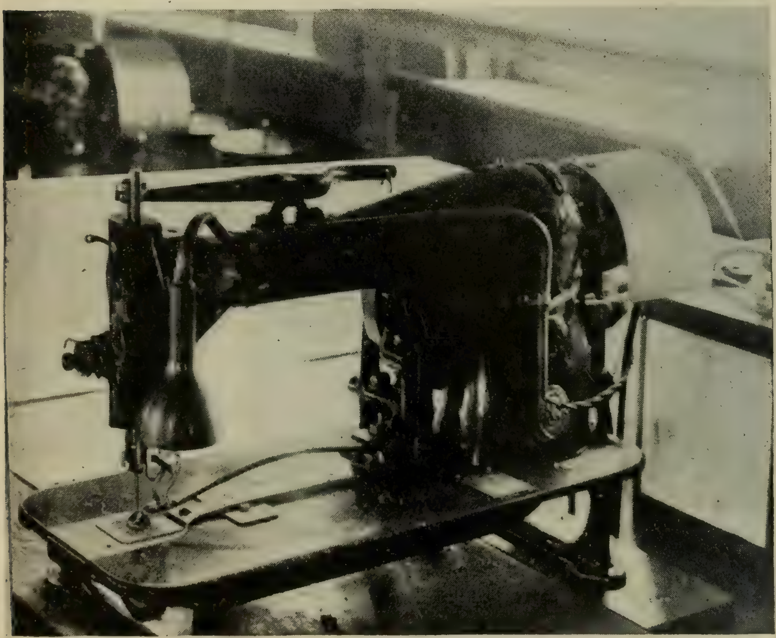


Fig. 7—Illustrating application of low voltage specific lighting system.

The comparatively insignificant cost of good lighting may be seen from the following figures, based on average cost of labor and materials in the States. You will note that the items are so separated and tabulated that it is a simple matter to change these calculations to fit any particular case.

One 100-watt Mazda lamp equipped with a good reflector will provide excellent illumination for a space 10′ x 10′, an area of 100 square feet. It is not unreasonable to allow 100 square feet of floor space to each employee in an industrial plant. This item may be larger in some instances and lower in others, but represents a pretty fair average.

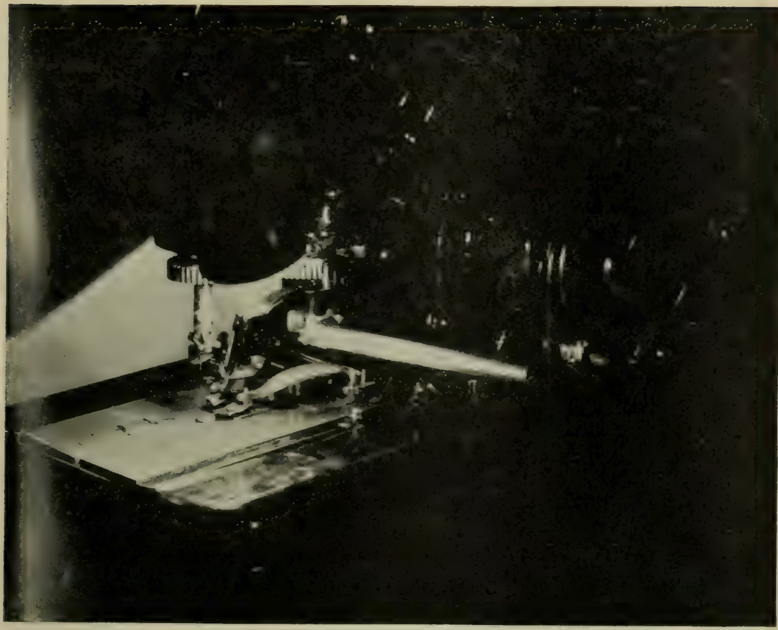


Fig. 8—Illustrating manner in which low voltage specific lighting system concentrates light on work.

The following figures are based on a factory operating 10 hours a day, 300 days per year.

Total working hours, 300 x 10	Hours	3,000
Total lighting hours, 300 x 3⅓	Hours	1,000
Average cost of labor per hour		35c.
Labor:		
3,000 hours at 35c.		$1,050.00
Light:		
Cost of 100-watt Mazda lamp (list)		1.10
Cost of metal reflector (trade price)		1.05
Average cost wiring per outlet		4.00
Initial investment per outlet		$6.15
Interest at 6% on $6.15		.37
Depreciation, 12½% on $1.05		.13
Depreciation, 5% on $4.500		.20
Annual fixed charges		$ .70
Cleaning, 12 at 3c. each		.36
Lamp renewals		1.10
Maintenance		$1.46

Power, 100 kw.-hr. at 3c.	$3.00
Annual operation cost	$5.16
Annual wages of 1 man	$1,050.00
Cost of light in per cent. of wages	0.49%

When reduced to cost per hour based on 3,000 working hours per year, we have:

Labor per hour	$ .35
Light per hour	.00172
Cost of light per day	.01720
Cost of labor per minute	.00583

To sum up on the basis of the assumptions made above, it is evident that the cost of good illumination per man amounts to 1.72c. per day, or equivalent to a man's time for 2.9 minutes—certainly a very small item. When this small cost is contrasted with the increased efficiency of workmen, the reduced liability of accidents, increase in production, improved quality of products, the cost of good illumination becomes all the more insignificant.

Fig. 9—Lighting of railway station platform.

The Mazda lamp is crowding its way into the illumination of railway stations and platforms. Scientifically designed installations make it possible for the waiting travelers to comfortably read their books and newspapers. Out over the platforms are found reflectors so designed as to lend a touch of ornamentation to the exterior of the station and at the same time dircet the majority of light emitted by the lamp down upon the platform so that the men driving approaching trains are not subjected to the glare of bare light sources. The incan-

descent lamp bids fair to be used in the headlights of locomotives in the near future. Drawn wire has made it possible to produce a very compact filament suitable for railway use. Parabolic reflectors project a beam of light from even a moderate sized lamp which is very intense. These lamps have a further advantage that the light is steady and has a color quality such that the color of semaphores and signal lamps is not distorted.

Fig. 10—Interior of a modern chair car.

Beauty and comfort are being striven for in the illumination equipment of our railway coaches. We find our dining cars lighted in a manner comparable to first class restaurants and cafés, while the Pullmans and day coaches are gradually being improved so that one may

read at night with the greatest comfort. The mail and baggage cars likewise are being electrically lighted in a highly efficient manner.

More common sense results are being aimed for on our passenger steamers. Our vessels are not being illuminated solely for dazzling effect, but for utility's sake. Effort is being made to light the staterooms in a manner comparable with the rooms in a first class hotel, while the passageways and salons, dining halls, etc., are being lighted beautifully and comfortably.

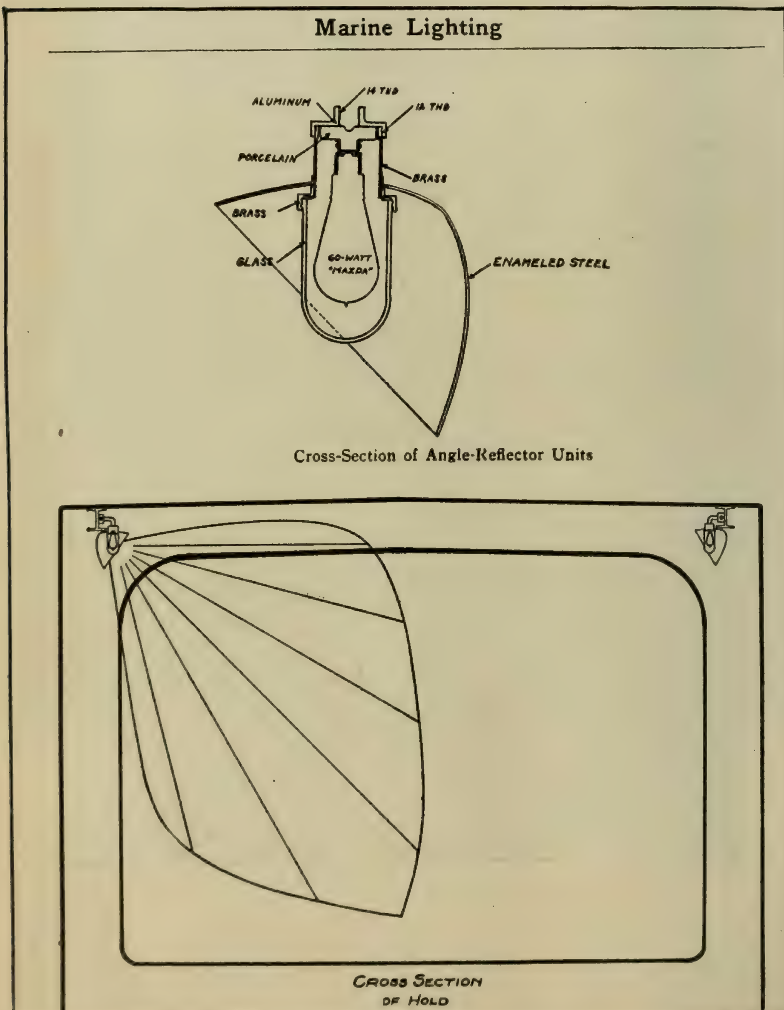


Fig. 11.

The Mazda lamp has found its way even into the lighting of freight and ore boats. By means of a unit recently designed, the holds of large lake ore steamers are being very satisfactorily illuminated, making the handling of ore at night easier and reducing the liability of accident to a marked degree.

Street lighting during the last few years has made great progress along all lines; not only through the use of incandescent lamps, but likewise through the use of gas and electric arcs. In the realm of incandescent lighting there is scarcely a large city in the States which does not have some form or other of incandescent street lighting. Here in the Dominion ornamental street lighting has been spreading rapidly. Simplicity, flexibility and ease of operation of this system recommend it. An incandescent street lighting system is adapted to almost any form of

Fig. 12—Street lighting with large units. Note tunnel like effect caused by widely spaced units of high candle power.

decoration. In the lighting of residence districts it is possible to cover large areas at a very moderate cost, thereby illuminating the dark areas which previously existed, when the only light sources were high candle-power arcs.

A few years ago the decorative effect of incandescent lighting seemed to be of most importance when illumination systems were considered for residences, churches, clubs, etc. At the present time utility, as well as decorative effect, is being given careful consideration.

Within the past two or three years vast quantities of glassware have been brought out for use in interior lighting. The beauty of many of these pieces is remarkable and the assortment such that units which will harmonize perfectly with almost any interior can be found.

Fig. 13—Modern ornamental street lighting system in Cincinnati, Ohio.

Fig. 14—Modern ornamental street lighting system in Dayton, Ohio.

Fixtures are being designed in a more common sense manner, and none the less beautifully than they have been in the past. For example—lamps and glassware were at one time largely used in an upright position. The reflectors directed a large percentage of the light toward the ceiling, allowing but little to reach the useful plane. In many cases a table or desk lamp was necessary in order that one might read comfortably. At the present time a large percentage of fixtures made carry their lamps and glassware in a pendant position, so that not only do the units look well, but efficient illumination is obtained.

Indirect lighting is becoming a great favorite along certain lines, especially in the illumination of auditoriums, libraries, drafting rooms, offices, living rooms in residences, restaurants, etc. The advantage of

Fig. 15—Note the pleasing detail of this room, brought out by a well designed system of artificial lighting.

indirect illumination for libraries, living rooms and auditoriums as well as offices is that one may work for hours beneath the well diffused illumination without experiencing any discomfort. In a drafting room the entire absence of shadows cast by the edges of triangles, T-squares, etc., is an advantage.

Cove lighting, while it has been used for a number of years, has received new impetus through the increased efficiency of incandescent lamps and the improved designs of reflectors.

Semi-indirect illumination, whereby the light is partly diffused direct through translucent bowls or urns and partly reflected from the ceiling is becoming very popular and is scientifically a most excellent

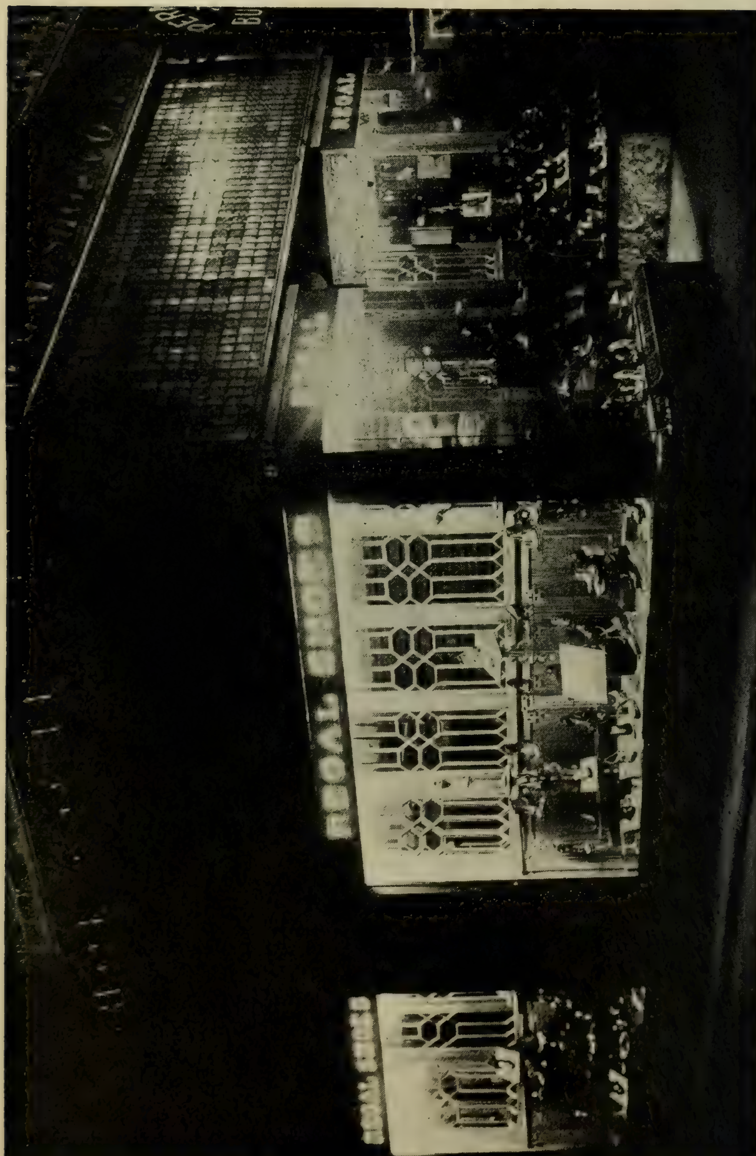


Fig. 16—A well lighted show window.

Fig. 17—Note the beautiful detail of this up-to-date show window.

system of illumination. This form of lighting is a great favorite in churches, auditoriums, residences, etc.

Four and five-hundred watt lamps are rapidly becoming favorites for the illumination of large stores, especially the main floors where ceilings are high. Much ingenuity is being displayed in the numerous artistic fixtures designed for use with the large lamps.

Show windows are more beautifully dressed and lighted to-day than ever before. The slogan "Light on the object—not in the eye" is applied for the most part in full. Merchants are coming to realize that it is necessary to build good windows in the first place; secondly, to light them properly, and, thirdly, to dress them well.

In concluding let me say that the outlook for great development during the year to come is exceedingly bright. Not only will we light areas efficiently and in a pleasing manner, but we will endeavor to do it in such a fashion as will be most beneficial to the eyes. Sight, which is undoubtedly the finest and most precious of our senses, must be cared for in the future more than it has in the past, as is evidenced by the increasing number of persons who wear glasses.

Mr. Henninger: I intend to show you a few slides, illustrating some of the results which have been attained by the use of indirect lighting.

Mr. Henninger then had some pictures thrown on the screen showing a number of different interiors, churches, offices, club rooms, etc., as they appear under indirect illumination. He then showed, by a number of pictures, the different means of illuminating show windows in order to get the best results, concluding with some views of mills and machine shops.

In conclusion he said: "The outlook for the coming year in the lighting field is excellent. I think we are going to give more attention to the proper kind of lighting, and are going to realize more than ever the importance of well-designed lighting systems. The increasing number of people who are wearing glasses should be a greater incentive for us to take care of our eyes more than we ever had before.. I have appreciated very much the kind attention you have given me. (Applause.)

The President: As Mr. Henninger pointed out, a satisfied customer is a very good investment and a very good advertisement, and, in my opinion, there is no better way in which you can make a satisfied customer than by helping him to obtain that which he needs when he does not know what he needs. You have to show him what is best for him, and when you have done that you have given him not only what will do his work best, but what will be most economical for him, and you have then a customer whom you can keep and who will be a living advertisement for your business.

The hour for adjournment having arrived the discussion of the papers was left over until the following morning.

The Convention then adjourned.

THURSDAY, JUNE 20TH, 1912, 10.30 A.M.—MORNING SESSION.

The President stated that the first item on the programme was the discussion on Mr. Henninger's paper, and asked Mr. McDunnough to open the discussion.

Mr. McDunnough: Mr. Chairman and Gentlemen:—A paper of the kind presented by Mr. Henninger yesterday is very interesting to all the members, but I think more particularly so to the managers of small central stations in towns and cities with up to 20,000 of a population. In these places the central station man has got to be a sort of Jack-of-all-Trades. He has to be the illuminating engineer, as well as many other things, and the examples shown us yesterday of illumination are bound to be of very great benefit to us. There was one thing that struck me in connection with the paper. We can take a store and fit it up and put in proper fixtures and proper glassware and proper globes, leave it with the customer and leave him in a perfectly satisfied condition, and we may go back again in a few weeks and find that he has replaced lamps which do not fit his glassware and he is not getting proper results. There is also another thing in regard to illumination. We put in a proper lamp and the lamp burns out, and instead of coming to us to replace these lamps the customer goes and buys them any place where he can get them, and instead of buying a three and a half watt lamp he buys perhaps a four or five watt lamp, and he does not get proper results. I would like to ask those present if that has been the experience they have had, and what steps they have taken to remedy this, and to keep the lamp situation in the hands of the central station managers.

Mr. Kelly: I thought it might be of interest to the members, in connection witn this subject, to relate what we have done in Hamilton regarding letting the merchants and manufacturers know about the developments in lamps, and also reflectors. Within one year after the velopments in lamps, and also in reflectors. Within one year after the wards we held meetings and had three different talks on illumination. These were given by men who were well versed in the art of illumination. We sent out invitations to merchants who we knew would be interested in the subject, and on those three different occasions we had very good meetings. Following that we went around to merchants interested and suggested changes in their lighting installations. These meetings and offers of assistance regarding laying out installations for merchants have been an immense help to us in satisfying our customers. This past year we went a little further. We co-operated last winter with the Board of Trade in Hamilton and sent out invitations through the Board of Trade to all the manufacturers in Hamilton. There are about four hundred manufacturers in Hamilton and representatives of about seventy-five were there. We had an illuminating engineer at the meeting, and

he went into the matter very thoroughly as to the lighting of mills and factories, and the result was that a number of the manufacturers improved the lighting of their factories and mills, and conditions in this respect were very much improved in Hamilton. With regard to Mr. McDunnough's question, we had somewhat the same difficulty as he had when we were selling fixtures to merchants, in having them use the proper size Tungsten lamps that their reflectors and holders were designed for. In some cases lamps had been changed and they were not getting the proper results, and that was one reason why we adopted the method we have in Hamilton. We have now two hundred stores in Hamilton lighted on the basis of our Tungstolier proposition. All of these stores have installations in accordance with our recommendation as to the number of fixtures, types of fixtures, whether equipped with one, two, three or four lamps, size of lamps and proper reflectors and holders. Under this Tungstolier maintenance proposition, if a lamp burns out we immediately replace it with the same sized lamp. The trouble, therefore, of the wrong lamp being used for the reflector and holder installed is eliminated. Regarding Mr. Henninger's paper, in reference to semi or indirect lighting, I am sorry to say, I have had no experience, but there is no doubt that when the discussion is closed a vote of thanks should be tendered to him for the very excellent paper that he has presented to the Association.

Mr. Higman: Might I ask Mr. Henninger if he knows of any progress being made along the line of lighting with luminous tubes operated by means of high potential and high frequency currents. With the use of such currents and with tubes exhausted to about one thousandth of an atmosphere, I have been able to produce in the laboratory results that would lead one to hope that this method of lighting might, in time, supersede the filament lamp. What I would like to know is whether any progress has been made in applying the system commercially?

Mr. McDunnough: There is another question I would like to ask with regard to electric signs, viz: Whether there is further development in the use of the low Tungsten lamp, or whether the practice is now to put in the standard voltage carbon lamp?

Mr. Henninger: Answering Mr. Higman's question, to my knowledge, about the only company in this country or on this continent that is doing anything with the luminous tube system of lighting is the Moore Tube Company. They put out tubes of varying lengths operated by high voltage discharge through a low-pressure gas. The carbon dioxide tube gives a light that approaches the quality of daylight very closely and is used to quite an extent in color matching. They make this illuminant in single tubes, which may be run almost anywhere, and, moreover, they make it up in compact form in a box about three feet by two feet. This is portable and may be set up any place where they can get the requisite A. C. to operate it. This small unit is used for color matching. Then they have tubes filled with nitrogen and hydrogen which gives the characteristic colors of those gases. We frequently see these in photograph

galleries, restaurants, and stores of various kinds. The main difficulty with the Moore light is that it takes an expert glass man to set up the apparatus, and if anything goes wrong with any portion of the tube, the entire system goes out of commission. Moreover, they have to have an automatic device to keep the vacuum at a proper value. This is accomplished by a little solenoid device which, when the vacuum gets too high, allows a little more of the gas to get into the tube, bringing the vacuum down and the operation is resumed. The long tubes have proven more efficient than the short ones because of the high percentage of loss at the terminals. That is where the biggest loss in the Moore tubes comes in. A representative of the firm at a Convention of Illuminating Engineering Society in Baltimore in 1910, stated that the long tubes were much more efficient than the short ones.

As to sign lamps, did you mean high voltage, Mr. McDunnough?

Mr. McDunnough: Low voltage.

Mr. Henninger: You can buy a two and a half watt lamp. That is about the lowest wattage regular sign lamp you can get at the present time.

My idea in writing this paper in the manner I did was simply to cover, in a general way, the advancements that have taken place in the lighting system within the last year or two, and I wanted to point out the various things which were considered worthy of notice. A couple of gentlemen and myself had rather a lengthy discussion after the meeting yesterday as regards the merits of direct, indirect and semi-direct illumination. If you want to start a vigorous discussion any place just bring up those three subjects, and as a rule you will find an advocate of each system on the ground. Now, I think a system of illumination has to be adapted to its particular use. There are cases where an indirect system of lighting is a very desirable thing, and there are cases where it is not desirable at all. You find some people who say it is an ideal light for drafting rooms, and other people say it is no good at all, that the semi-indirect is what you should have. It is claimed that the entire absence of shadow makes it impossible for the draftsman to see when his pencil touches the paper. To my mind diffusion is the keynote of the situation there. We have been using an indirect lighting system in our drafting room and we find it very satisfactory. Our tracing, of course, is all done on a specially constructed tracing table lighted from beneath. That might be interesting to some of you. Several years ago, when we were doing our tracing in the old-fashioned way with ordinary thin tracing paper placed over a blue print, we found it a rather difficult job, so what we used to do then was to take a big piece of glass out of a blue print frame and lay it across two desks and put a lamp under it and make our tracing on this improvised equipment. Well, it seems that plate glass is apt to have some "peculiar stresses" set up within itself when it gets hot, and once in a while a glass will break. This happened to us; not only did the glass break, but in falling the lamps' reflectors beneath it were also broken. We then designed a table which was made

up in somewhat the form of a light, tight box, fitted with a plate glass top. Incandescent lamps fitted with angle steel reflectors are arranged so as to illuminate uniformly the plate glass top of the tables. Blue prints placed over this glass may be traced with the greatest of ease. In order to keep the glass from getting too hot we have a little fan, which blows the air through the tables.

Now, as to the relative efficiency of direct, indirect and semi-direct illumination you will find that if you take direct illumination as one hundred, the semi-direct illumination will average somewhere around seventy-five, and the indirect will average somewhere around fifty per cent. These figures will vary according to local conditions, the color of the walls and ceilings, and so on. These things must all be considered, and I should not want to say that any one of these forms of illumination is the only form to follow up. A lighting installation to my mind ought to be unique in itself. We try to have our homes fitted up a little different from our neighbors'. Things would be rather tiring and monotonous if they were the same, and the same thing applies to a lighting system. What we must remember in applying the above-mentioned principles is that all light sources have to be kept out of the range of vision, and the light properly diffused. I think the reason why a great many people in the past have claimed that oil lamps are better to read by than electric lamps is simply because they misused the electric. The oil lamp flame gives somewhere between six and twelve candle power. Now, a person can look at an oil lamp flame without any discomfort, but when you come to a carbon lamp with a candle power per square inch of approximately three hundred and eighty, and when you come to the Tungsten filament, which gives about a thousand candle power per square inch of filament surface, the eye is subject to great strain. It has been proven that a brilliancy of more than eight or ten candle power per square inch is trying on the eye, and to attempt to do any work with a candle power of one thousand before our eyes causes all kinds of trouble. We must educate the public to the proper kinds of illumination. There are very few of the central station companies that have not someone in their employ who knows what lamp is required and the reflector which should be used with it, and if we can educate the merchants and users of lights to ask for such information when they are not sure, we will have more satisfied customers. When reflectors, holders and lamps are designed to work with one another it does seem a shame to have such misuse of them.

I do not know whether you have seen it, but there is an indirect lighting system in the barber shop of this hotel, and the men down there seem to think it is a pretty fine system. As I pointed out in one of the pictures yesterday the reason that people are taking so quickly to this form of lighting is because it is so well diffused. You can hardly go wrong on it. You are bound to get good diffusion if the ceilings are light, for you get rid of the glare, and, naturally, the users think it is excellent. It is a case of diffusion, keeping the light sources out of the

range of vision. I did not expect when I came here that everyone would agree with all the opinions I might express, but if we all thought alike we would have a rather humdrum existence. (Applause.)

Mr. MacLachlan: Has anything been done to get rid of the ultra violet in electric lighting from the Tungsten and the carbon lamps? We have this difficulty to face in opposition to gas.

Mr. Henninger: Are you quite sure there is no ultra violet in the gas?

Mr. MacLachlan: It is very low.

Mr. Henninger: I never heard anyone complaining about the ultra violet in the Tungsten lamp or the carbon lamp. The percentage contained is very low indeed. You see the temperature at which the Tungsten filament operates is considerably below the temperature of the electric arc, and the percentage of ultra violet light produced is very small when compared to the arc. The glass bulb serves to strain out the ultra violet, so that the percentage of ultra light that finally gets away from the carbon of Tungsten filament lamp is very small indeed. One of our men who was making extensive color analysis of the light coming from the Quartz tube lamp was a little careless and did not wear a pair of glasses, and his eyes were in very bad condition for a couple of weeks. He said they felt as if they were full of sand. On a number of occasions we have had people ask us if they couldn't use the Mazda lamp for photographic work. In trying to get a short-time exposure anything like that which you can get from the Quartz lamp or the arc lamp, the Mazda lamp is simply out of the question. It requires quite a long exposure, or an excessive power consumption.

Mr. MacLachlan: The problem is being discussed in England at the present time, and they are getting out a dip to be used with the Mazda lamp to get rid of the difficulty.

Mr. Henninger: Well, speaking of dips for a Mazda lamp, we have developed a so-called daylight dip, but its function is to screen out the excess of red and get a light very close in quality to what you get from a clear north sky. We have succeeded in getting a very good dip, indeed, and the beauty of it is that it can be applied to the smallest as well as the largest Mazda lamp, but we had no idea of eliminating the ultra violet light there.

Mr. W. W. Grant: What is the relative efficiency under similar condition of an indirect lighting system such as you speak of in the barber shop and the system such as we have in this room?

Mr. Henninger: Do you mean to compare all frosted lamps such as we have here with the indirect system, using clear lamps?

Mr. Grant: Yes.

Mr. Henninger: The lamps in this room are carbon filament lamps. But, supposing they were both the same kind of Mazda lamp, using the all-frosted lamps, the lamps being in an upright position, not being equipped with reflectors which tend to throw the light down, I imagine the system downstairs would be somewhere in the neighborhood of 50 to

75 per cent. as efficient as this. Getting the highest efficiency out of an indirect lighting system and the highest efficiency out of a direct system you will find, under ordinary circumstances, the indirect is in the neighborhood of 50 per cent. as efficient as the direct, when the light is produced by the same expenditude of power.

It has been claimed that one can see better under an indirect lighting system than under a direct lighting system. This question has been discussed in a great many places and at great length. I should say the whole thing will be determined by the diffusion of the light. Naturally, if you have a powerful lamp of great brilliancy hanging down in front of your face you will not be able to see as well as with, perhaps, one-quarter or less of that light properly diffused.

Mr. Kemble: Just for the benefit of Mr. MacLachlan, in reference to people having trouble with their eyes, I may say that for the last five or six years I have been using a Tungsten lamp that has been dipped in a solution of potassium bichromate. The result is that it works very much as a color screen in photography. It cuts out about sixty per cent. of the ultra violet light and adds a little bit of the red. In my experience it is the red in the gaslight, and particularly in the kerosene oil lamp that makes the old-fashioned lamp so good to work by. If you take a frosted lamp and dip it in a solution just strong enough so that it will crystallize under heat, I think you will find little or no trouble with complaints on that score.

Mr. Henninger: I may say that the eye works most efficiently under a light of yellowish tone.

Mr. R. Hornby: I note Mr. Henninger did not mention in his examples of indirect lighting in shops the case where there was a box with lamps inside. I noticed in Berlin, Germany, some shops that were lit by means of a screen over the top of the window, boxed in according to Mr. Henninger's color description, while one or two arc lamps were suspended in a big window above. This gave a very rich yellow and well-diffused light. It is rather expensive, but the distinction in quality is possibly worth the extra cost. I do not know if you use those here.

Mr. Henninger: I do not know of a single case where electric arc lamps are being used to light windows. There are a number of cases where merchants are using gas arcs on top of the window, but as for the use of flame arcs, I hadn't heard of them before, and I do not know of any such installations in this country. I should think one difficulty from the use of it in the interior of the shop would be on account of the fumes of the lamps. Of course a great many of the lamps are provided with cooling chambers, but even at the best some of them are not very good.

Mr. Hornby: The shop window itself is quite covered in, you know. There is a roughened glass or sanded glass put over the top of the window. The lamp is quite outside the shop window.

Mr. Henninger: The lamp is placed up above the glass screen?

Mr. Hornby: Yes, with a reflector on the lamp to throw the rays down through this ground glass. It gives a very nice effect.

Mr. Henninger: I should think that would give a very good effect. Of course it would be subject to the variations in the arc. An arc lamp at the best will flicker. Of course the glass ceiling would tend to diffuse the light.

The President: I am sure that Mr. Henninger deserves the thanks of this meeting for having brought this important subject to our attention in such an interesting manner. He has given us a great deal of detail on a matter which is of interest to us all, and we are very thankful for his kindness.

The next item on the programme is the reading of a paper which was left over from yesterday afternoon, and I will now ask Mr. S. Bingham Hood, of the Toronto Electric Light Company, to read his paper on ''Distributing Systems for Outlying Districts and Smaller Plants.''

Mr. S. Bingham Hood: This is rather a long paper and as the time is short I will hurry over it. The question of overhead distribution is one that affects both the larger and the smaller companies, and I do not think it has been brought down to the standard that some of the other apparatus has. For instance in our water powers we take all kinds of pains, but not so with the distribution systems.

THE CONSTRUCTION OF DISTRIBUTION SYSTEMS FOR OUTLYING SYSTEMS AND SMALLER PLANTS

S. Bingham Hood

Toronto Electric Light Company

In establishing an electricity supply service in small villages, or the more or less scattered population surrounding our larger cities, the problem becomes much more complex, both commercially and electrically, than that of the supply within the city itself. Most of the earlier small systems were constructed in a crude makeshift manner and gave at best anything but what we class to-day as reliable service. The men who financed these small plants seldom had any electrical knowledge and frequently operated the system as a side line to their regular business—the power plant being located in some local mill or factory with the idea, generally, of using the prime mover for factory operation during the day and making it work overtime to earn its salt by driving a small generator at night. The operator of the plant, a local jack of all trades, attended to inside wiring, did the construction work on the lines; installed, read and repaired the meters (unless it was a flat rate proposition), and in his spare time operated the plant. The natural result was generally that, where the system was growing, he had no time to attend to operating duties and the service became unreliable in proportion to its prosperity —at least until such time as the unreliability overshadowed the prosperity and the whole undertaking went on the rocks. This was the favorite time for the big fish to swallow the little one and has resulted quite generally in the present-day suburban systems being owned and operated by the large system of the nearest city, the local plant under these conditions being abandoned and supply obtained from the large central station.

The result of this has been of great benefit to the local suburban community, in that they not only obtain the primary supply from a modern station giving the highest class of service, both as to reliability and efficiency, but also have at their command a skilled, specialized force to design and supervise the local distribution and operation.

To successfully and profitably operate a large scattered suburban load the construction of the distribution system must be the very best that can possibly be obtained, in order that an uninterrupted service may be given. This requirement is even more imperative than within the larger community, as the suburban system must to a considerable extent be automatic in its operation owing to the difficulty, time, and expense, necessary to restore interrupted service due to line failure at points remote from the operating headquarters. Combined with this

DATA SHEET—REPORT OF THE COMMERCIAL CO

NAME OF COMPANY	City, Town, Village	Province	Population	Have you Electric Competition	Private or Municipal Competitor	Have you Gas Competition	Artificial or Natural	Do you maintain a separate dept. to secure New Business.	If not, do you expect to start one this year.	How many persons have you actively engaged in soliciting business.	How Divided Power, Lighting, Electrical Appliances	How paid, Salary or Commission or both	Do you maintain a display or demonstration room to interest customers in electrical appliances.	If not, Why?	What appliances do you send out on trial.	Do you accept payment for electrical appliances in instalments	Do you advertise	
British Canadian Power Company	Cobalt	Ontario	5,000	Yes	Private.	No		No	No	One	Not divided	Salary.	No	Explained.	None	No	Yes	Follow-up letters
British Columbia Electric Railway Co	Vancouver	B.C.	150,000	Yes	Private.	Yes	Artificial	Yes		Six	Not divided	Salary	Yes		Irons	Yes	Yes	Electric sign, new
Chatham Gas Company Ltd	Chatham	Ontario	11,000	No		Yes (own plant)	Natural	Yes		Two	Not divided	Salary	Yes		Irons, vacuum cleaners, toasters	Yes	Yes	Newspapers, stre
Canadian Niagara Power Co'y	Niagara Falls	Ontario																
Canadian Electric & Water Power Co	Perth	Ontario	3,500	Yes	Municipal	No		No	No	One	Not divided	Salary.	Yes		Irons	Yes	Yes	Electric sign, Nev
Cape Breton Electric Co'y Ltd	Sydney.	Nova Scotia	23,000	No		No		Yes		One	Not divided	Salary	No	Explained.	None	No	Yes	Electric sign, new
Citizens Electric Co. Limited	Smith's Falls.	Ontario	7,000	Yes	Private.	No		No	No	2 or 3	Not divided	Salary	No		Irons, toasters	Yes	No	
Georgian Bay Milling and Power Co	Meaford	Ontario	3,500	No		No		No	No				Yes		None	Yes	Yes	Newspapers
Halifax Electric Tramway Co	Halifax.	Nova Scotia	47,000	No		Yes (own plant)	Artificial	No					No	Explained.				
Hamilton Electric Light & Power Co	Hamilton	Ontario	90,000	Yes	Municipal	Yes	Both.	Yes		Six	Power 1, Lighting 4, E A 1	4 salary, 2 s.& c.	Yes		Toasters, disc stoves, toaster stoves, fans, irons, illuminous radiators.	Yes	Yes	Key tags, empty letters, street
Hull Electric Co'y	Hull	Quebec																
W. Johnson & Son	Lloydminster	Sask	1,000	No		No									Irons, disc stoves, fans	Yes	No	
Kaministiquia Power Co'y	Fort William.	Ontario																
La Cie des Eaux et de l'Electricite de Chicoutimi	Chicoutimi	Quebec	6,000	No		No		No	No				No		None	Yes	Yes	
Leamington Light & Heat Co	Leamington.	Ontario																
London Electric Co'y	London	Ontario	47,000	Yes	Municipal and Private	Yes	Artificial	No	No	Three	Not divided	Salary	Yes		Any heating or cooking appliance.	No	Yes	Newspapers, prog
MacLaren, Albert, Electric Light	Buckingham	Quebec																
Montreal Light, Heat & Power Co'y	Montreal	Quebec	480,000	Yes	Municipal and Private	Yes (own plant)	Artificial	Yes				Salary & Com.	Yes		Irons	No	Yes	Electric sign, elec
Mattawa Electric Light & Power Co'y	Mattawa	Ontario																
North Bay Light, Heat & Power Co	North Bay	Ontario	9,000	No		No		Yes		One	Not divided	Salary	Yes		Irons	Yes	Yes	Electric sign, new
North Shore Power Co	Three Rivers.	Quebec	15,000	No		No		No	No				Yes		Fans, irons, toasters, stoves	Yes	Yes	Electric sign, new
Ontario Power Co'y	Niagara Falls	Ontario																
Ottawa Electric Co'y	Ottawa.	Ontario	90,000	Yes	Municipal	Yes (own plant)	Artificial	Yes		Six	Power 1, Lighting 5.	Salary & Com.	Yes		None	No	Yes	Electric sign, new
Peterborough Light & Power Co	Peterborough	Ontario	19,000	Yes	Private.	Yes (own plant)	Artificial	No					No	Explained.	Irons	Yes	No	
Petrolia Utilities Co. Ltd	Petrolia	Ontario	5,000	No		Yes (own plant)	Natural						Yes		None	Yes	Yes	Newspapers, prog
Philip, John	Grand Valley	Ontario	1,200	No		Yes	Artificial	No	No				No			No	No	
Prince Rupert Hydro Electric Co	Prince Rupert.	B.C.																
Pembroke Electric Light Co	Pembroke	Ontario																
Quebec Railway, Light, Heat & Power Co	Quebec	Quebec	80,000	No		Yes (own plant)	Artificial	No					No	Explained.	Irons	No	No	
Richmond County Electric Co'y	Richmond	Quebec	3,000	No		No		No					Yes		None		No	
Renfrew Power Co. Ltd	Renfrew	Ontario	4,000	Yes	Private.	No		No	No				Yes		Irons, toasters	Yes	No	
Sarnia Gas & Electric Light Co	Sarnia	Ontario	10,000	No		Yes	Natural	No	No				Yes		Irons, toasters	Yes	Yes	Electric sign, new
Stayner Electric Light Co	Stayner	Ontario	1,000	No		No		No	No	One	Not divided		No	Explained.			Yes	Newspapers.
St. Francis Hydraulic Co	Thetford Mines	Quebec																
St. Johns Electric Light Co	St. Johns	Quebec	10,000	No		No				One	Not divided	Salary	Yes		Irons	Yes	No	
Sydney Mines Electric Co	Sydney Mines.	Nova Scotia																
Sorel Light & Power Co. Ltd.	Sorel	Quebec	10,000	No		Yes	Artificial	No	No	One	Not divided	Salary	No		Everything	Yes	Yes	Electric sign, billb
Tagona Water & Light Co'y	Sault Ste. Marie.	Ontario	15,000	No		No		Yes		One	Not divided	Salary	No	Explained.		No	Yes	Folders, meter rea
Toronto Electric Light Co	Toronto	Ontario	400,000	Yes	Municipal	Yes	Artificial	Yes		24	Power 5, Lighting 15, Elec. Appli. 4	Salary	Yes		Irons, toasters	Yes	Yes	Electric sign, new
Toronto Power Co'y	Toronto	Ontario																
Trenton Electric & Water Co	Trenton	Ontario	4,000	No		No				One	Not divided	Salary	Yes		Irons, toasters	Yes	Yes	Electric sign, new
Trenton Electric & Water Co.	Belleville	Ontario																
Walkerville Light, Heat & Power Co.	Walkerville	Ontario	3,500	No		Yes	Natural	No	No				Yes		Irons, vacuum cleaners, toasters	No	Yes	Newspapers, folde
Watrous Electric Light, Power & Traction Co	Watrous	Sask	1,250	No		No		No	No	Two	Not divided	Salary	Yes			No	Yes	Electric sign, new
Western Canada Power Co	Vancouver	B.C.	100,000	Yes	Private.	Yes	Artificial	Yes		Eight	Not divided	Salary	Yes		Irons, toasters	Yes	Yes	Follow-up letters, folder

...es do you send ...n trial.	Do you accept payment for electrical appliances in instalments.	Do you advertise.	WHAT MEDIUMS DO YOU USE	Do commercial lighting customers pay for first set of carbon lamps.	Do you renew carbon lamps free to commercial lighting customers.	Do domestic lighting customers pay for first set of carbon lamps.	Do you renew carbon lamps free to domestic lighting customers.	Are customers required to call at office to renew lamps.	Does your Company do inside wiring.	Do you accept payment for this in instalments.	Does your Company sell electric lighting fixtures.	Do you accept payment for this in instalments.	Does your Company sell electric motors.	Do you accept payment for this in instalments.	Do you supply Tungsten lamps to customers on a rental and maintenance proposition.	If you have no objection to your light and power rates being published kindly attach copies of your rate schedules and contracts.	Would appreciate receiving data regarding any scheme you have of securing business.
	No	Yes	Follow-up letters	Yes	No	Yes	No	Yes	No		No		No		No	Not furnished	No suggestions.
	Yes	Yes	Electric sign, newspapers, street car, folders, follow-up letter	No	Yes	No	Yes	Yes	No		No		Yes	Yes	No	Furnished	No suggestions.
...aners, toasters	Yes	Yes	Newspapers, street car, billboards, follow-up letters	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Rates furnished, no contracts	No suggestions.
	Yes	Yes	Electric sign, Newspapers, programs, monthly bulletin, folders, follow-up letters	Yes	Yes	Yes	Yes	Yes	No		Yes	Yes	Yes	Yes	No	Not furnished	No suggestions.
	No	Yes	Electric sign, newspapers, programs	Yes	No	Yes	No		No		No		Yes	Yes	Yes	Not furnished	No suggestion.
	Yes	No		Yes	No	Yes	No		Yes	Yes	Yes	Yes	Yes	Yes		Rates furnished, no contracts.	No suggestions.
	Yes	Yes	Newspapers	Yes	No	Yes	No		Yes	Yes	Yes	Yes	No		No	Rates furnished, no contracts.	No suggestions.
				Yes	No	Yes	No		No		No		No		No	Furnished	No suggestions.
...es, toaster stoves, ...nous radiators.	Yes	Yes	Key tags, empty house notices, newspapers, monthly bulletin, folder, follow-up letters, street car tickets.	No	Yes	No	Yes	Yes	No		No		No		Yes	Furnished	Covered by paper entitled "New Business" read at Convention.
...fans	Yes	No		Yes	No	Yes	No		Yes	Yes	Yes	Yes	Yes	No	No	Rates furnished, no contracts.	No suggestions.
	Yes	Yes		Yes		Yes		Yes	Yes	Yes	Yes	Yes	No			Not furnished	No suggestions.
...oking appliance	No	Yes	Newspapers, programs	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes	No	Not furnished	No suggestions.
	No	Yes	Electric sign, electric outline, newspaper	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	Not furnished	No suggestions.
	Yes	Yes	Electric sign, newspapers, programs, folders	Yes	No	Yes	No		No		No		Yes	Yes	No	Not furnished	Suggestion.
...rs, stoves.	Yes	Yes	Electric sign, newspaper, folders	Yes	No	Yes	No		Yes	Yes	Yes	Yes	Yes	Yes	No	Rates furnished, no contracts.	No suggestion.
	No	Yes	Electric sign, newspaper, programs, folders, follow-up letters	Yes	No	No	Yes	No	Yes	Yes, thru Contractors	Yes	Yes	No	No	No	Not furnished	Suggestions.
	Yes	No		No	No	No	No		No		No		No		No	Not furnished	No suggestion.
	Yes	Yes	Newspapers, programs	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Furnished	No suggestion.
	No	No		Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	No		No	Rates furnished, no contracts.	No suggestion.
	No	No		No	Yes	No	Yes	No	No		No		Yes	No	No	Not furnished	No suggestion.
		No		Yes	No	Yes	No		Yes	No	Yes	No			No	Furnished	Suggestion.
	Yes	No		Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	No		No	Rates furnished, no contracts.	No suggestion.
	Yes	Yes	Electric sign, newspapers, folders	Yes	No	Yes	No		No		No		Yes	Yes	No	Rates furnished, no contracts.	Suggestion.
		Yes	Newspapers	Yes	No	Yes	No	Yes	Yes	No	Yes	No	No		No	Furnished	No suggestion.
	Yes	No		Yes	Yes	Yes	Yes	Yes	No		Yes	No	Yes	No	No	Furnished	No suggestion.
	Yes	Yes	Electric sign, billboard, monthly bulletin, folders, follow-up letter	Yes	Yes	Yes	Yes	Yes	No		No		Yes	Yes	No	Not furnished	No suggestion.
	No	Yes	Folders, meter reading slips	Yes	No	Yes	No		No		No		Yes	Yes	No	Furnished	No suggestion.
	Yes	Yes	Electric sign, newspapers, programs	Yes	No	No	Yes	No	No		No		No		Yes	Not furnished	No suggestion.
	Yes	Yes	Electric sign, newspapers	No	No	Yes	No		Yes, thru Contractors	Yes	No		Yes	No	No	Not furnished	Suggestion.
...ners, toasters	No	Yes	Newspapers, folders, follow-up letters	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Furnished	No suggestion.
	No	Yes	Electric sign, newspapers, follow-up letters	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Furnished	Suggestion.
	Yes	Yes	Follow-up letters, electric sign, newspapers, billboards, monthly bulletin, folders	No	Yes	No	Yes	No	No		No		Yes	Yes	No	Not furnished	Suggestion.

requirement the annual overhead charges must be kept as low as possible in order to make the distribution profitable. These annual charges reach a minimum where the design and construction of the distribution system is such that a maximum life is obtained with a minimum capital expenditure. Failure to realize this point was the downfall of the early systems where every effort was made to ''make it cheap,'' with the result that the life of the system was limited to but a few years. At just what point maximum efficiency results is hard to determine. Local conditions may make a design adapted to one locality an expensive one for another. The best materials may be selected to cover the mechanical construction, but an electrical system may be adopted which may be so expensive that the combined cost becomes prohibitive. Generally speaking, however, maximum economy has been reached where the interest charges equal the ones for depreciation. In other words, the cheaper you can get your money the more you can afford to spend to lengthen the life of the distribution system.

In addition to this the first cost of current plays an important part. In water power plants or large turbine steam plants the cost of current at the bus bars is very low, and, consequently, the line losses in transmission may be made somewhat high to advantage, particularly in suburban work where the load factor is generally low. Right here, however, a word of caution is opportune. You can make your line losses between the source of current and the point where first load is taken off anything within reason; but between the nearest and furthest load your total drop in pressure, including both primary and secondary, as well as transformer drop, must not exceed five per cent. if you expect to give service in its true sense. You can't operate a feeder with a drop of anywhere from ten to twenty-five per cent. and start loading it at the city limits and leave off at Farmer Jones' half a mile beyond the next village. We all know this, but still seem to keep on trying, with results similar to our railway friends with their efforts to eventually make a single track line operate successfully without sidings.

If we analyze the cost of suburban transmission we find that the pole line (such systems being nearly always overhead) represents the greatest proportionate investment. We also find that this portion also has to carry the larger share of the depreciation, due to its limited life under ordinary conditions. We, therefore, intend to take up first of all this part of the work and endeavor to show where maximum economy can be obtained. In suburban and semi-suburban work a thirty-foot pole line is amply high enough where the run is free from trees or other obstructions. Special cases will, of course, require higher poles, but the average condition is covered by the sizes shown in Table 1. The prices here apply to average conditions of labor and material costs in the vicinity of our larger cities.

The cost of pole in the rough is that of good clear B.C. cedar, with an increase in diameter of one inch for every ten feet. The cost of shaving, framing and treating covers shaving from ground line to roof,

TABLE. I

INVESTMENT AND ANNUAL COST ON POLES.

ITEM	SIZE AND KIND	COST IN ROUGH	SHAVING FRAMING TREATING	HAULING	PAINTING AND STEPPING	SETTING	TOTAL	LIFE (YEARS)	ANNUAL COST
1	30'×6" PLAIN	$3.06	$1.10	$0.45	$1.36	$3.50	$9.46	6	$2.05
2	30'×6" TREATED	" 3.06	" 2.20	" .45	" 1.35	" 3.50	" 10.56	11	" 1.49
3	30'×7" PLAIN	" 5.00	" 1.10	" .45	" 1.39	" 3.50	" 11.44	7	" 2.21
4	30'×7" TREATED	" 5.00	" 2.30	" .45	" 1.39	" 3.50	" 12.64	12	" 1.69
5	35'×7" PLAIN	" 6.00	" 1.30	" .48	" 1.64	" 3.75	" 13.17	8	" 2.30
6	35'×7" TREATED	" 6.00	" 2.60	" .48	" 1.64	" 3.73	" 14.47	13	" 1.84
7	35'×8" PLAIN	" 7.50	" 1.30	" .48	" 1.68	" 3.20	" 14.76	10	" 2.21
8	35'×8" TREATED	" 7.50	" 2.75	" .48	" 1.68	" 3.80	" 16.21	15	" 1.89
9	35'×7" PLAIN + RESET	" 6.00	" 1.30	" .68	" 1.84	" 7.35	" 17.17	15	" 1.89
10	35'×7" TREATED + RESET	" 6.00	" 2.60	" .68	" 1.84	" 7.35	" 18.47	20	" 1.71
11	35'×8" PLAIN + RESET	" 7.50	" 1.30	" .68	" 1.88	" 7.40	" 18.76	18	" 1.87
12	35'×8" TREATED	" 7.50	" 2.75	" .68	" 1.88	" 7.40	" 20.21	23	" 1.76
13	35'×7" TREATED RETREATED + RESET	" 6.00	" 3.80	" 1.38	" 1.64	" 7.35	" 20.17	25	" 1.67
14	35'×7" TREATED BRUSH RETREATED + RESET	" 6.00	" 3.60	" .48	" 1.64	" 7.35	" 19.07	23	" 1.65
15	30' STEEL POLE PAINTED	" 8.75		" .40	* 7.50	" 5.00	" 21.65	30	" 1.62
16	30' STEEL POLE GALVANIZED	" 12.75		" .40		" 5.00	" 18.15	25	" 1.63

* EVERY 3 YEARS

taper or wedge roofing, cutting and boring of gains and boring for steps and sockets. The treating, where same is included, consists of a double immersion of the butt, to one foot above ground line, in carbolinium oil. First immersion to be in hot oil and second in cold.

Painting is for one coat, in pole yard, of entire pole above ground line. This coat preferably to be of a light body paint or stain, such as shingle stain, which will penetrate into the surface for an appreciable distance. The object of painting is primarily to improve the appearance of the pole, as any pole line is objectionable from the public's standpoint and anything which renders it less so is a first class investment. In addition a coat of stain undoubtedly does act as a preservative to a considerable extent. The object of stepping and socketing the pole is also to prevent its being cut up by continual climbing with spurs, which not only spoils the appearance of the line, but leaves countless little holes or pockets to collect water and drain it right into the heart wood of the pole. Steps are, or should be, standard ⅝-in. by 9-in. hot galvanized and have a life far beyond that of the pole in which they are to be used. The best form of socket is a malleable iron or wrought iron thimble which will drive into a ⅞-in. hole. The hole in thimble will take a ½-in. lag screw or pin which is slipped in by the lineman when about to climb a pole, and taken out when he comes down. Four of these sockets are required for each pole, making the first step come seven feet from the ground. As the sockets are not readily removable after once driven, their life is, of course, that of the pole into which they are placed.

The cost of setting given in the table is that for average digging in hard clay or loam. This column for items 9 to 14 is original cost of setting, plus the cost of cutting oc, digging out old butt, and dropping down and retamping the balance of pole.

The life of pole is taken as that point where the butt rot at ground line has decreased the sound diameter to that of the top of pole. This life varies widely with different conditions of soil, climate, etc., but figures given represent a fair average. For treated pole the life is uncertain owing to lack of definite data. The writer has taken the increased life as being five years for a pole with 7-inch top, as poles so treated have been under observation for this length of time and some are starting to show signs of decay, while others are as good as the day they went into the ground. Where this decay has started there is no means of telling whether it is going to be the same as an untreated pole, or faster or slower. Five years increased life is, therefore, taken as the known increase.

Table I shows sixteen sizes or combinations of poles suitable for suburban or semi-suburban conditions, fourteen of which are wood. In figuring the annual costs it is assumed that the value of pole will be entirely wiped out at expiration of given time. The steps can probably be used over again and the pole may have a slight resale value, but these at best will only cover removal costs. It will be noted that while

the investment costs vary by over 100 per cent. the annual costs only vary about 35 per cent. Taking the average of these annual costs, which is $1.84, and eliminating all above the average we have the following to select from:—

	Cost.	Annual Charge.
30′ x 6″ treated	$10.56	$1.49
30′ painted steel	21.65	1.62
30′ galvanized steel	18.15	1.63
35′ x 7″ treated, brush re-treated and reset	19.07	1.65
35′ x 7″ treated, re-treated and reset	20.17	1.67
30′ x 7″ treated	12.64	1.69
35′ x 7″ treated and reset	18.47	1.71
35′ x 8″ treated and reset	20.21	1.76
35′ x 7″ treated	14.47	1.84

It is interesting to note that no untreated pole comes below the average. The 30 by 6 appears to be the winner, although such a pole is hardly strong enough for supporting transformers, corner poles, etc. Assuming that every fifth pole should be 7-inch top we get an average cost per year of $1.53. This clearly shows that butt treatment is a great economy, and, if such treatment should turn out to give a life as long as the makers of the carbolinium claim, the economy will be very much greater. For this class of work the writer recommends the use of 30-foot treated poles for branch secondary lines, using 6-inch for straight runs and 7-inch for strains and corners. For trunk lines requiring primary wires a 35-ft. pole should be used, 7-in tops meeting all usual requirements. While the table gives the annual cost of such a pole as $1.84, the actual cost with above suggested arrangement is less owing to our having a good framed 30-foot pole left from the old 35-foot when it requires renewing at the end of 13 years. This brings the annual cost of the 35-foot pole down to $1.33 or less than the 30-foot poles. This saving would, however, not be possible unless we used 30-foot for standard branch lines, as otherwise the old cutoff 35-foot poles would be dead wood on our hands.

The theory of wood preservation must be clearly understood by those attempting the treatment if success is expected. Wood rot is caused by a living microbe, and, to sustain life we must have all of three things—LIGHT, AIR and WATER. Each one of these microbes throws a tendril or thread to the point where all three of these conditions exist, and these tendrils may be many feet in length, as they are in the case of dry rot, or heart rot. Deprive these organisms of any one of the three essentials to life and we have solved the problem of preservation. If we keep our pole above ground in condition to shed water, by filling all exposed end grains and preventing damage to the exterior surface, we have eliminated water from this part of the pole and insured against surface rot. A short distance below the ground line both light and air are eliminated, so that our danger zone is confined to

a few inches above the ground and about one to one and one-half feet below the ground. It is this portion which requires preservative treatment and compound which will permanently exclude the air fulfils the purpose, and it is not necessary that this extend entirely through the pole as the organism is going down through the heart cannot obtain light and cannot live. The only really successful compound for this purpose appears to be some of the coal tar by-products, of which the dead oil, known to the trade as carbolinium, appears the best. A brush treating process can meet with but indifferent success owing to all timber being more or less filled with season cracks or checks, the interior of which can not be reached with a brush. The immersion treatment requires two open tanks, one for hot and one for cold oil, each capable of holding eight or ten poles, which are hoisted by a derrick and their butts set vertically in the tank. In addition a storage tank is desirable and a small circulating pump with suitable piping and valves connecting all three tanks. For heating the oil a furnace may be built under the hot tank, or, better still, a small steam boiler provided and steam coils immersed in the tank. Where current can readily be obtainable the heating can be done conveniently by means of low pressure resistance coils placed directly in the bottom of the tank, a suitable grid being placed to keep the weight of poles off the coils. Such an equipment should be installed for from $1,500 to $2,000, and will pay for itself in a very short time.

The growing scarcity of timber suitable for poles is rapidly forcing up the price until it seems that a few short years will make it necessary for us to use some other material with which to support our overhead lines. For voltages between those that can be handled with bare hands and those too high to handle alive a wooden or other form of insulated pole has its advantage. For high tension transmission and for low tension secondary distribution, however, a metal pole has no objectionable features. It would seem, therefore, that we should conserve our remaining forests for use where wood is advantageous, and substitute some other material for the balance of our requirements. The past few years have seen many improvements along these lines, steel towers for transmission lines being used to-day almost exclusively. For trolley systems the tubular iron pole has been in use for urban lines for many years. Reinforced concrete has also been tried with varying success and gives promise of ultimately being successful.

The concrete pole has been adopted for all secondary distribution by one of our larger Canadian cities, and we can well afford to wait and see how these work out before experimenting ourselves to any great extent. These poles are from 25 to 30 feet in height, of square section with beveled corners. They run about six inches at top and eight to nine at the butt. Re-inforcement is with four one-half inch rods, one in each corner, about one inch from the surface. The cost in position is about the same as that of a treated cedar pole, and, theoretically, there should be no limit to their life. Personal observation, however, pre-

cludes their being recommended by the author. It is surprising the amount of rough handling these poles will stand and the extent to which they will bend without breaking. The peculiarity seems to be their failure after they are in position and the wires in place. Where they can be head guyed so that practically no strain is placed on them they work admirably considered simply as props, with a vertical load only. Two forms of failure have been noted; first, that where the head guy has given and allowed a strain to come on the pole. In this case the beam has its fulcrum at the ground line and a tremendous leverage takes place, which draws the re-inforcement, on the side under tension, right out of the concrete. This could be overcome by fastening the lower ends of the re-enforcing rods in some kind of a plate, but would probably result in the strain breaking the rods instead of pulling them out. The other failure appears to be due to a tortional strain from uneven balancing of the wire pull at the top. In this case the outer shell of concrete near the top is entirely broken off and the rods with the concrete core piece twist around until the strain is equalized. On straight runs they may prove successful provided the use of numerous anchor guys is not objectionable; but in taking off service lines serious difficulties come up, as it is hardly practicable to side guy every pole where a service line is required.

Another apparent inherent defect in these poles seems to be the shrinkage cracks in the concrete. In many cases these are quite prominent and extend over three sides of the pole, being very pronounced on the side opposite the strain. It is very evident that the re-inforcement is carrying all the strain and equally evident that water is getting at the rods, as well as air. Just what effect this is going to have on the life of the pole time alone will tell.

The writer's idea of what would be a successful reinforced concrete pole would be to have a circular cross section, the reinforcement to be in the form of a tapered tube of either expanded metal or electrically welded mesh. To avoid deterioration this could be hot galvanized as a whole at small expense. The concrete would be moulded around this tube, which should be covered not less than one and one-half inches. To lighten the pole and save concrete a tapered mandril about two inches smaller than the inside of the re-inforcing tube could be placed in the mould and withdrawn after the concrete had partially set. A pole of this kind would require pouring with the mould set on end, the entire proposition of development being one almost too great for any individual company to handle alone. Some of our enterprising manufacturers will, no doubt, eventually take up the development of such construction and put it in commercial shape.

Tubular steel poles up to 30 feet are now a standard product. A pole of this height and heavy enough for distribution strains can be set in concrete at a cost of about $30.00 each. Where provided with a re-inforcing band at the ground line and the concrete carried up sufficiently above ground to act as a water shed the life should be at least 25 years.

With this life, and allowing for its scrap value the annual charge would be $2.46, or about two-thirds greater than for a wooden pole. At the rate the cost of timber is going up a few years will put iron and wood on an equal footing for such use.

Structural iron poles can be developed easily along the same lines as standard transmission towers, but on a smaller scale. One company is now making a light three-legged tower at very moderate cost and numerous designs could be brought out using galvanized standard shapes

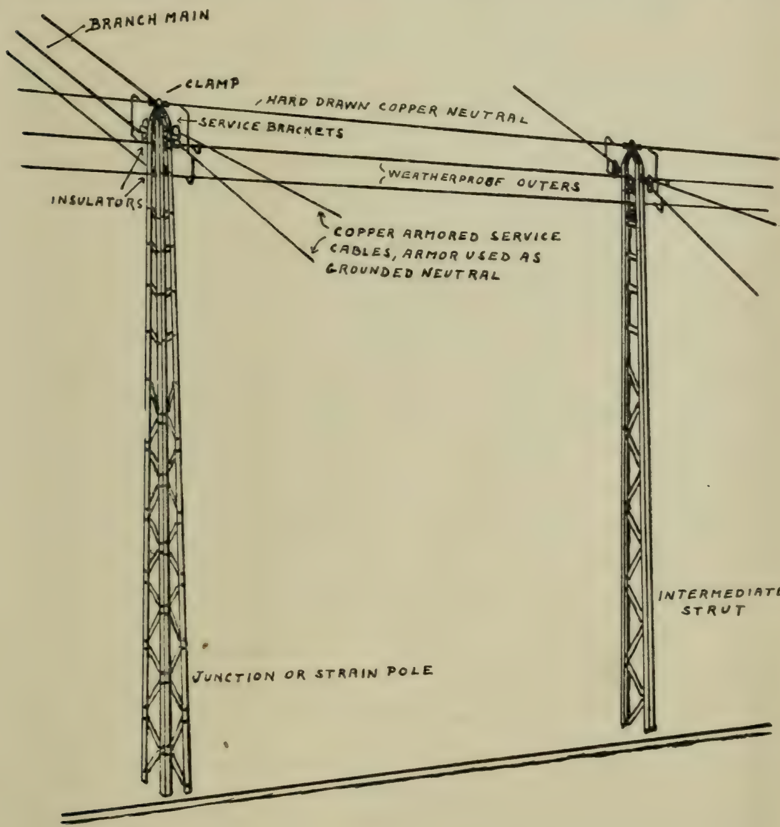


Fig. 2—Steel Pole Secondary Distribution

and giving a pleasing appearance with ample strength. A built up pole can be made at a cost in position not exceeding twenty dollars. The life should be at least twenty-five years with an annual cost of less than $2.00 or little greater than a wood pole line. In fact, the writer has in mind at the present time a system of construction in which about every fifth or sixth pole would be of the tower type (see Fig. 2), the inter-

mediate poles being simply latticed struts set to take up a right angle strain due to service lines. The tops of these poles would be solidly connected by a hard-drawn copper wire which would act as a stay wire, and also a grounded neutral for the distribution system. The annual cost per pole for this idea will run approximately $1.60, or about the same as the wood pole line. These costs can probably be further cut down by bolting new ground sections to the old poles at the expiration of the original life, as little or no depreciation should occur above the ground if four test galvanizing is insisted upon.

Pole Fittings and Hardware.

The permanency, reliability and overhead charges of a distribution system depend probably more on the hardware and fittings used than upon any other item of construction. In the days of early development very light poles were the rule and their life was generally not over five years; consequently, any fitting which would last as long as the pole was considered good enough.

With the adoption of a treated pole giving a life of twelve years or more very different fittings are required. For high tension lines, or those of over 600 volts, the wooden cross arm is probably the best means of supporting the wires, as its insulating qualities are of considerable advantage. Cross arms of standard dimensions as specified in the overhead line committee's report of the National Electric Light Association, together with the hardware for cross-arm attachment as specified in this report, should be used by all electrical distribution companies where the wires are supported on cross arms. The standard sizes are not only those which practice has shown to be suitable for the work; but, even with the greatest care, accidents are bound to happen and an acknowledged standard method of construction is of considerable advantage in defending a lawsuit.

The ordinary cross-arm, however, even where of standard dimensions, is not good enough for use with treated poles unless specially selected and treated. An exception to this may possibly be made if the arms are of genuine hard yellow pine. This grade of wood is expensive and very heavy to handle, and, while strong, is not nearly as strong as its weight would seem to indicate. The softer woods, such as stock arms are generally made from, are absolutely worthless unless treated. These arms generally show heart rot first, and may appear perfectly good on the outside and actually be but a shell, which indicates that the weak point is the exposed end grain in the pin holes. To overcome this it naturally follows that any method of treatment must be before the pins are inserted and also that a brush treatment is useless. For treated cross-arms straight grain clear spruce is without doubt the best material. Arms of this wood are very light and exceedingly strong and tough for their weight. If treated with carbolinium oil the wood should be first kiln dried and then immersed in the hot oil until it refuses to absorb any more, several successive baths being given; the final one being in cold oil. The best treatment for cross-arms is, however, that of "Kyan-

izing,'' in which the timber is rendered absolutely sterile and will give a life of twenty years or more under most severe climatic conditions. Kyanized timber is to all appearance the same after as before treatment, and must be painted to give a good appearance if used in built up localities as in villages or towns. A Kyanized spruce arm will cost approximately 50 per cent. more than the common stock arms, but, when it is considered that it has from three to four times the life, it becomes an excellent investment, particularly when it is considered that the labor cost of changing an arm may exceed the actual cost of the arm itself. For pinning cross-arms only locust pins should be used and only those with 1½-inch shanks. Oak pins are just about as treacherous as stock cross-arms as they rot off at the shoulder in a short time. When it is considered that a broken pin may cause an interruption to an entire distribution system, and that the proportionate costs of the pins in comparison with total cost of the line is infinitesimal, any attempt at economy on this article is worse than poor engineering, and is, in fact, criminal if the pole line is on a public highway. For the same reason, too much dependence should not be placed on a single pin, and double arms should be used at all angles and junctions, and, preferably, also on the first pole on each side of a strain pole. These double arms should be provided with two spacing or spreader bolts in addition to that holding the arms in position. Various forms of spreaders have been tried out from time to time; but the writer has found the best form to be a wood block with a transverse hole to receive a standard through bolt. These blocks are frequently made in the field from a section of standard cross-arm, but a far better practice is to have them made from 3-inch by 4-inch surfaced stock, treated the same as the arm. The blocks may be made in lengths of from 18-inch to 24-inch, and can then be cut to proper length as required; the 11/16-inch hole being bored through the entire block at the mill.

Locust wood suitable for pins is becoming so scarce, and, at best, a wood pin is the weakest point in our suspension system, that metal reinforcement or entire metal pins are being used more and more as the demand for permanent construction increases. These pins range all the way from the ordinary wood pin with a ⅜-inch iron rod inserted in it to the all metal pin. Attempts have been made to standardize a metal pin of malleable iron having a 1½-inch shank to fit the old style of arm. This style has not found favor, however, owing to the arm then becoming the weakest point. Malleable pins have also been found objectionable owing to the tendency to split the insulator due to unequal expansion between the iron and the glass or porcelain. In order to overcome this, metal pins with wooden tops are used extensively, the common form being simply the old wood pin cut off at the shoulder and bored to receive a ½-inch carriage bolt. A similar style uses only the threaded portion of wood, the base being a porcelain spool which slips over the bolt. Probably the oldest style of metal pin is the Western Union,

which has been standard for many years with telegraph companies. This pin has not, however, the necessary stiffness for electric light work.

The best metal pin designed to pass through the arm is undoubtedly a design which has been placed on the market within the past year. This is of high carbon steel with bolt ½-inch in diameter. The shoulder is increased in diameter and drawn square, which not only stiffens the pin, but provides a wrench hold. The contact point with the arm is swaged out to form a good-sized shoulder, and the insulator thread is formed of a steel wire spiral which slips around in the insulator thread when expanding and contracting. This absolutely prevents insulator breakage

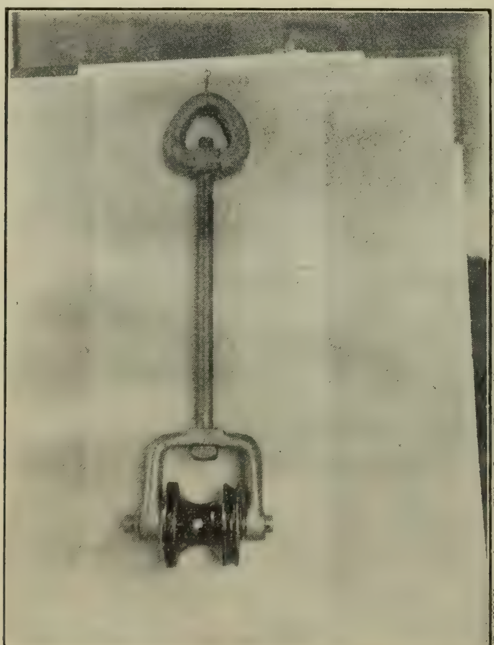


Fig. 3—Dead Ending Clevis.

and also that very annoying property of insulators to unscrew and become loose on the pin. These pins cost about three times that of a locust pin, but are an excellent investment, as, being hot galvanized, there is practically no limit to their life, and, while they may be bent, they will never break and drop the line. Another feature that makes them an economy is the small amount taken out of the arm for the pin hole. A wood pin leaves only 2 inches of wood out of a total of 3½ inches, while the steel pin leaves 3 inches, or fifty per cent. more, which not only adds to the strength of the arm, but also materially to its life. For heavier strains the same makers have recently brought out a clamp pin

made of a bend of ¾-inch channel. A "U" bolt of flat steel is used to clamp this to the arm and insulator support is their usual steel spring thread. Such a method of fastening effectually does away with any possibility of the arm splitting and for heavy or important feeder lines makes an excellent job at very moderate increase in cost, the pin and clamp complete averaging about twenty cents.

For dead ending a line, particularly with large wire, the best pin made is an unsafe proposition and for such use some form of strain insulator with bolt right through the double arms should be used. The writer has not located up to date a device which can be purchased in the open market and which meets the requirements. We are using, however, a malleable iron clevis adapted to take a standard ⅝-inch bolt and using a porcelain spool insulator held in position by a ⅝-inch pin with cotters in each end (see Fig. 3). These can be made up cheaply in any shop and make a dead end that can't get away. We also use a ⅝-inch eye-nut where it is desired to head guy the arm, this placing no strain on the arms other than actually holding up the weight of the line.

The balance of pole hardware is now standardized, but, above all, should be hot galvanized only; plain iron for bolts or braces being both an expensive and dangerous proposition for use with treated poles, as they will not outlast the pole which should be the first part of the line to give out from age.

For taking off services and branch lines we are all familiar with the wooden side block and the reverse or buck arm. For junction poles at important corners the latter may be necessary, but for other places either is such an eye-sore that their use should be condemned in the strongest terms. For this purpose some form of metal spreader bracket should always be used. Various styles of malleable iron brackets have been on the market for years, but have defects which are too well known to need mention here. Fortunately it is now possible to obtain a full line of wrought steel brackets to meet every possible need. These are unbreakable, of light weight, and have a spring thread similar to the metal pins mentioned above. As the heaviest pattern of three-pin bracket costs only about one-half dollar, and a light two-pin about 20 cents, the cost is low enough to make their use general. For attaching to buildings the same line of brackets are available, together with a number of other styles adapted to building use only. With such fittings available there is no longer any excuse for unsightly and slipshod methods of taking off or attaching service leads.

A method of running secondary distributing mains which is finding favor within the past few years is that of dispensing with cross-arms altogether. The three wires of the system are carried in a vertical plane on brackets fastened directly to the pole (see Fig. 4). A three-pin metal bracket for this purpose will cost erected about 50 cents, which is less than the cost of a cross-arm. With this method of suspension the lines can not swing together, and, consequently, can be placed on very short spacing, decreasing the inductive drop on A. C. lines. A further

advantage of this method is the ability to take off service lines directly from the line pins without crosses in the line. For dead ending these lines a three-spool insulator bracket is used, secured to the pole with two ⅝-inch through bolts, forming an anchorage which will stay as long as the pole holds up. As we have a number of 500,000 C. M. mains carried on this type of bracket some idea of their strength can be realized.

Fig. 4—Vertical Secondary Distribution.

Reference to the illustrations will demonstrate the vast gain in appearance which can be made with this type of construction in comparison with the old cross-arm method.

Before going into the question of wires a few words on the subject of joint poles may be opportune. Aside from the beneficial effect of minimizing the number of poles on the highway, as regards public opinion, the joint use of poles offers great economy both as to first cost and upkeep expenses. The telephone or telegraph is found practically every place where electric light or power is required, and there is no valid reason why both classes of public service companies can not beneficially co-operate to utilize each other's investment to the maximum. Where both systems are on the same street, as they must be to supply service, there is always the chance of the two systems becoming crossed owing to falling wires. This is equally true irrespective as to whether they are on separate pole lines or on a joint pole. For ordinary

distribution under suburban conditions of load density a pole heavy enough to properly carry either system will just as safely carry both. This is due to the strength of a pole considered simply as a prop being far greater than the maximum load it must bear. With the wires and services of two systems on the same pole the bracing effect would be materially greater than where each system has its own pole line. With up-to-date construction where the lighting secondaries are carried in a vertical plane on brackets and the telephone is either lead cable carried

Fig. 5—Joint Pole.

on a messenger wire, or drop wire carried in rings for short branches, the appearance of the line can scarcely be considered as an objection beyond that which is an unavoidable evil made necessary by advance in our civilization (see Fig. 5).

From the financial standpoint we will assume for argument that the one company selects as a standard a 30-foot by 6-inch treated pole costing $10.56 in position and having an annual charge against it of $1.49. The other company must cross and re-cross the first line and finds these conditions require a 35-foot pole with 7-inch top, costing $14.47, and having fixed charge of $1.84 per year. The total expense to both companies is then $25.03 per pole, with a total annual charge of $3.33. The average charge would then be $12.52 and $1.66 respectively. Now,

the joint pole line proposition, using the 35-foot by 7-inch pole, would only cost each company $7.24 capital expenditure and $0.92 annual charge, a clear saving to each of about 42 per cent. in investment and 44 per cent. fixed charge. In actual practice it is not necessary or desirable to have any real joint ownership. All that is required is a working agreement between the companies, giving the methods of construction necessary to make a uniform standard, and some provision as to notification when one company desires to utilize a pole belonging to the other. Having such an agreement compensation can be based on a yearly rental. By referring to Table 1 it will be at once evident that, under ordinary conditions of suburban distribution a rental of one dollar per year per pole would average about right and require little or no bookkeeping to keep the accounts straight. It is fair to suppose that, where true co-operation exists, as it should, one company would use the other company's poles about equally, so that any excess or deficit in the rentals would be wiped out by the law of averages. Indeed, were it not for the standing given any joint pole agreement due to a definite compensation being established, there would be no real reason for establishing any charge whatever between th respective companies.

Having selected the various fittings which combine to form a uniform method of construction the actual running of the wire is a simple matter. Any economy to be gained here is largely that due to the selection of a distribution system adapted to the requirements of the load to be served. As to the kind of wire to use, copper is the only choice. Aluminium wire may offer economies for transmission work, but for ordinary distribution it is unsuitable owing to the large span dip necessary to avoid overreaching the tensile strength of this metal. This extra dip would usually mean a higher pole, the cost of which would offset the saving in metal. In addition, aluminium, owing to its light weight, and greater area for same conductivity, will swing and whip around in a wind to an extent that introduces all kinds of complications where space will not permit wide separation of the conductors.

For suburban distribution we need consider only A.C. systems. The frequency is based upon that of the generating plant from which primary energy is obtained. This is generally already fixed before local distribution is considered and may be anything from 25 to 60 cycle. For lighting 60 cycle has undoubtedly some advantages, but the idea that frequencies as low as 25 cycle are impractical for this purpose is entirely in error, provided your generators have a wave form approximating a smooth true sinu-soidal curve. Low wattage metallic filament lamps show a very bad flicker on frequencies below 30, but it is so easy to educate the public to the use of higher candle power units for the economical lighting of rooms, in preference to several small units, that this objection is not serious. In lighting large areas indoors, for amusement places principally, where large numbers of small units are used, the "25 cycle flicker" is very pronounced as soon as the illumination exceeds a certain critical point. In this case the flicker should be welcomed as a

warning that the bounds of good illumination are being exceeded; the flicker being a sure sign, if noticeable, that the eye of the observer is under undue strain owing to excessive amount of light entering the retina; consequently it is unable to adjust itself to the variations in intensity between cycles. For arc lighting low frequencies are objectionable, but as the arc for interior illumination is now practically obsolete, having been replaced by tungsten clusters with greater all round reliability and efficiency, low frequencies do not introduce serious complications here either.

Taking all these points into consideration there is no reason for complicating the system by introducing frequency changers. If the frequency is not already selected, and rotary converters are not intended to be operated on the system to any great extent, then 60 cycle is probably the best standard to adopt. If the bulk of the output will be used for power purposes then a lower frequency may offer some advantages, and, for American practice, 25 cycle would be the standard. Unfortunately this particular frequency does offer some slight disadvantages from a lighting standpoint, as mentioned above. Experiments have shown, however, that just slightly above 25 cycle these defects disappear. With this in mind a running frequency of about 27½ is a marked improvement and can be obtained by simply running standard 25 cycle apparatus proportionately overspeed.

For the generating equipment there is no question but what multiphase current is necessary. This may be either two or three-phase with the latter far in the lead as regards efficiency of distribution. For this reason only the three-phase system will be considered. This system is commonly operated delta connected, but of late years the star connection is finding more and more favor where distribution networks cover large areas. In fact, the writer ventures a prediction that the next decade will see all our systems operated star connected with a solidly grounded neutral. If we stop to consider that, under operating conditions, our insulation strain is nearly always that between phase wire and ground, and not that between wires, it is at once clear that operating at only 58 per cent. of the voltage which our insulation is designed to stand is pretty poor economy. We can reconnect the same apparatus in star and operate the same line to transmit three times the power. In order to operate successfully in this manner it is imperative that the neutral points of the star be solidly grounded, not only at the ends, but at frequent intervals on the line. With this grounding there will always be more or less earth current which may cause interference with adjacent telephone or telegraph companies. To minimize this it is advisable to run a neutral conductor throughout the network, so that under only abnormal conditions will the earth be called upon to carry current. As ground lines have been demonstrated to be advantageous for lightning protection, and are quite generally in use on transmission systems, it is only necessary to substitute a wire capable of carrying the maximum

neutral current in place of the ground wire, the added expense being slight.

The question of grounding is one which has been under discussion for years past, but which to-day is still being argued. The advisability of grounding below 250 volts is seldom questioned, the problem being simply that of getting a permanent ground. Here, however, the problem is supposed to be one of life hazard only, and the increased efficiency and reliability of a system when its position in relation to earth potential is definitely established appears to have been entirely overlooked. Any electric circuit, unless effectually grounded at some established potential point, is like a lost soul floating around in space. Its potential to earth may vary by thousands of volts, irrespective of its normal working voltage.

It has been a fixed law of the universe from the days of the creation that all things must start from the earth's surface, either up or down. The writer is firmly convinced that electric circuits are no exception to this law, and, unless we firmly anchor them to the earth, sooner or later something will happen with disastrous results. This subject is one which alone could be made to cover a paper as large as the Good Book we all try to follow, and, as the proof of the pudding is in the eating, those who have not tried grounding can get all the proof needed by adopting this method. By "grounding" we mean, however, SOLID GROUNDING, and not driven pipes, plates buried in coke, so-called grounding cones, limiting resistances and what not. A pipe forming a portion of a buried piping system is the only successful ground the writer has so far discovered. Our results following grounded operation lead us to believe that every electric circuit should be grounded, irrespective of the voltage at which it operates. In transmission circuits the objection to solid grounding has always been that a ground on any of the three-phase wires renders the system inoperative. This is undoubtedly true, but if the system has normally operated ungrounded, will not some unexpected weak point break down when subjected to full potential to ground? In this case, and it will be true in many cases, the system will fail to operate anyhow. It is very nice from an operating standpoint to hang on to our load to the limit. But, as engineers, is it good policy to continue in operation a system after it has developed what is known to be an abnormal and dangerous fault?

With the three-phase four-wire system, having solidly grounded neutral, there is one advantage which particularly applies to suburban distribution where the lighting load forms a large proportion of the whole. This is the ability to operate two of the phases after the third has developed a fault which renders it inoperative. The load of faulty phase can be transferred to one of the good ones and the lighting and single phase motor load carried until permanent repairs are made.

For suburban and semi-urban distribution it does not follow that because our generating system is three-phase the entire distribution must be the same. For lighting circuits the simplest and best secondary

distribution is the single-phase three-wire system. In order to permit of inter-connection of these secondaries into a network covering a considerable area a single-phase primary is desirable. With this in mind it is now an almost uniform practice to distribute lighting by single-phase sub-feeders, either balancing on different phases at the main bus or at selected points on a three-phase feeder line. For power distribution it used to be considered necessary to have multi-phase currents, but recent developments have overcome this for motors of small size, say up to 15 horse power. For these the modern single-phase motor fulfils all requirements and greatly simplifies the distribution and metering problem. Motors on suburban lines seldom exceed five horse power and up to this size they can usually be operated off the lighting network, unless frequent starting and stopping is necessary and their use extends regularly over into the lighting peak. In this case, and in motors of larger size, individual transformers are desirable. Where these are necessary they should have their neutral point connected to the lighting neutral, which, of course, is solidly grounded. If this point is overlooked we do not properly protect our power customers against high tension crosses or leakage.

As to the point where it pays to distribute three-phase from the sub-station or generating station in preference to single-phase, neglecting demands which may arise for large motors, this is where the investment for copper, in position, for the three-phase (four-wire) feeder equals that for a single-phase line. As No. 4 wire is the smallest which should be used for distribution and give the requisite margin of mechanical safety, it will be found that a No. 0 single-phase line is the largest that should be run. In fact, if No. 0 is required then preference should be given to the four No. 4 wires operating three-phase grounded star.

After having overreached the economical bounds of single-phase feeder distribution and having adopted three-phase, the question comes up as to at what limit the latter becomes uneconomical when operated at the utilization voltage, or the voltage at which the distribution transformers are operated. This limit has been increased three-fold by the adoption of the four-wire system, and it is now possible to transmit at the working voltage a considerable amount of power over a considerable distance. A No. 2/0 circuit will deliver about 300 K.W. a distance of ten miles without exceeding economical limits of line loss under ordinary suburban load conditions and average initial power costs. This is sufficient to feed a pretty well developed suburban town.

A rough rule which has been used for some years is to allow 1,000 volts per mile. This is simply a rule of thumb, and is disproved right in the above case where this rule if applied would demand a transmission voltage of 10,000 in place of 4,000 as shown.

In the transmission of moderate amounts of power the craze for high voltage transmission lines can very easily get the best of our common sense if we are not careful. The general rule in this regard is that the annual cost of energy lost in the line equals the annual cost for

depreciation and interest on the line when maximum economy has been reached. In those cases where the selected voltage requires either step up or step down transformers, or both, the cost of these, together with their switching arrangements, must be included in the line investment. In many cases the cost of these, if put into additional copper, would carry the same amount of power with equal economy and cut out just that many links in the chain of trouble.

In designing any line the prospective future growth of the territory must be considered, and if this is promising and will eventually overreach the economical limits for 4,000 volts, then the line should be designed for high tension operation. In doing this it is as well to go the limit, which for this class of work is about 25,000 volts. The extra cost for wider spacing and larger insulators is so small that the extra investment is certainly warranted if future prospects look at all good. Such a line can be operated at 4,000 volts until such time as it becomes loaded. Step up or down transformers can then be installed and the change over made. There is no good reason for operating higher than reasonable requirements demand, and, consequently, the transformers should be purchased with double primary coils and operated at half voltage until the full pressure is required.

For distribution over a large area from a central generating station the writer particularly favors a method which is only made possible with the adoption of a solid grounded neutral three-phase four-wire system. This is the use of auto-transformers in preference to the regular double coil type. It will be shown later on how these work out for general distribution, and their use in transmission will now be explained. With the grounded neutral system and using step down transmission, we would have in the complete system, under ordinary practice, no less than three neutrals; the secondary, the primary, and the transmission (Fig. 6). Each one of these being solidly grounded is to all intent and purpose one wire as far as potential is concerned. The natural thing to do is to combine them mechanically as well as electrically (Fig. 7). The neutral current distribution is somewhat complex and, while capacity must be provided to carry the greatest unbalanced load, in practice the currents are very small. In using a common neutral for all systems a single wire of the same cross section as the larger of the three separate neutrals will fulfil all requirements. The current distribution in such a common neutral is somewhat peculiar in that the drop on either circuit appears to be only that due to its own current and not that of the combined currents flowing. The heating effect may be that due to the combined currents or may be much less, as, under certain conditions, the neutral current from one system will flow in the opposite direction to that in the other and consequently tend to neutralize it. This is one of the great economies made possible by a solidly grounded neutral.

As regards the auto-transformers, as used for transmission. Take a single coil transformer having its winding split up into four equal sections, each having a voltage of 2,300 (Fig. 8). As a regular

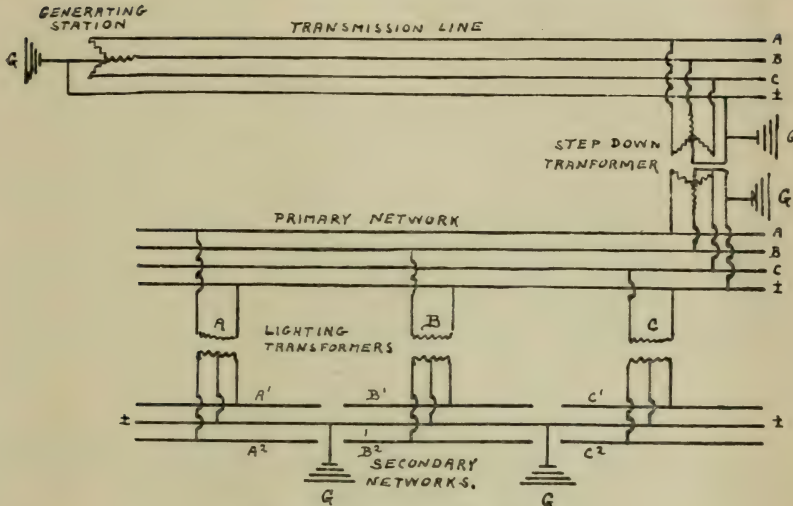


Fig. 6—Separate Grounded Neutrals.

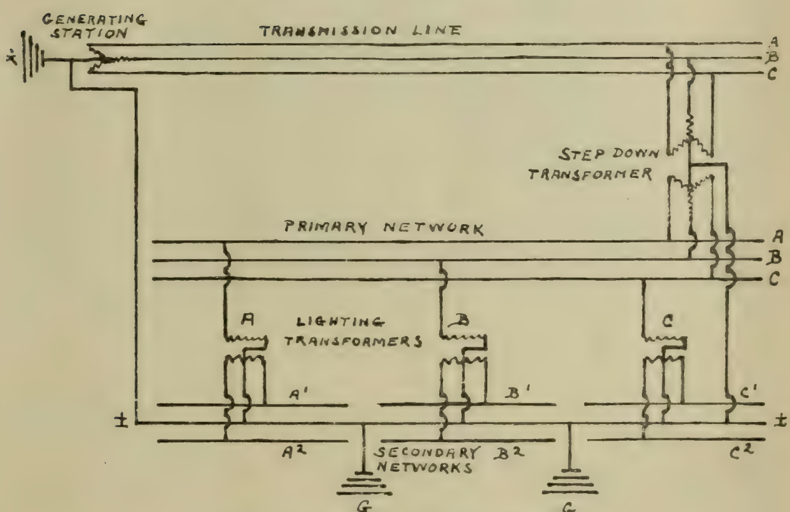


Fig. 7—Common Grounded Neutral System.

transformer assume this to have a capacity of 100. Connecting these coils two in parallel and the two sets in series we get an auto-transformer of 1 : 1 ratio (Fig. 9). One end of the coil goes to neutral, the middle to the distribution phase wire, and the other end to the transmission phase wire. Here we transmit at approximately 8,000 volts on the delta and step down to 4,000 volts for distribution, the star voltages being respectively 4,600 and 2,300. The capacity of this auto

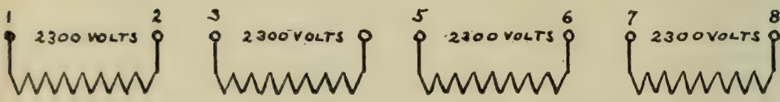


Fig. 8—Development of Winding, Four Coil Auto-Transformer.

would then be 200 and the investment for transformers but one-half that for the straight transformer connection as now generally used.

By connecting two of the sections in series and these in turn in series with the other two coils in parallel we get a ratio of 2 : 1 and transmit at approximately 12,000 volts delta with a capacity of 150 (Fig. 10), the transformer investment being but two-thirds that of the old method. A transformer of this kind would be insulated for 7,000

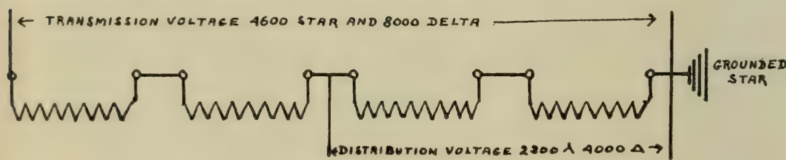


Fig. 9—Auto-Transformer Connection One-to-One Ratio.

volts between coils and core and proportionately between coils; but at no time would but a small portion of the winding be operated under this pressure, which would drop uniformly, throughout the winding, from maximum to zero.

This same principle can be carried out up to the highest limits of transmission voltages, but, of course, the economy in transformer investment becomes less as the ratio between distribution voltage and transmission voltage becomes greater. In very high voltages a further saving in transformer costs may be effected in that the maximum insulation need be only that for the star voltage and this insulation can

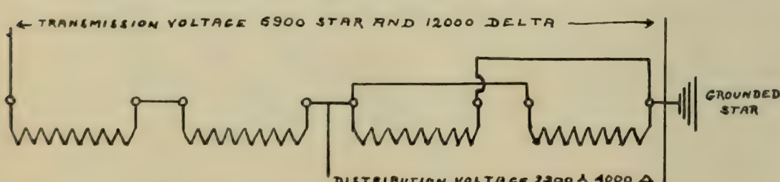


Fig. 10—Auto-Transformer Connection Two-to-One Ratio.

then be shaded down from this to a very small amount at the earthed star connection, only one high tension bushing being required, as it will never be necessary to reverse the windings in order to get the star voltage distribution to come right.

Another point of economy in the grounded neutral is that where a portion or all of the circuit is carried through lead covered cables. With a neutral not solidly grounded a four-core cable is necessary.

With the solid ground it is not even necessary to pull in a bare conductor in the ducts as we already have a lead sheath capable of carrying, in a 3-core, 250,000 C. M. cable, about 100 amperes without heating enough to interfere with capacity of the cable (Fig. 11). By bonding all sheaths together a combined capacity far in excess of any normal requirement is obtained.

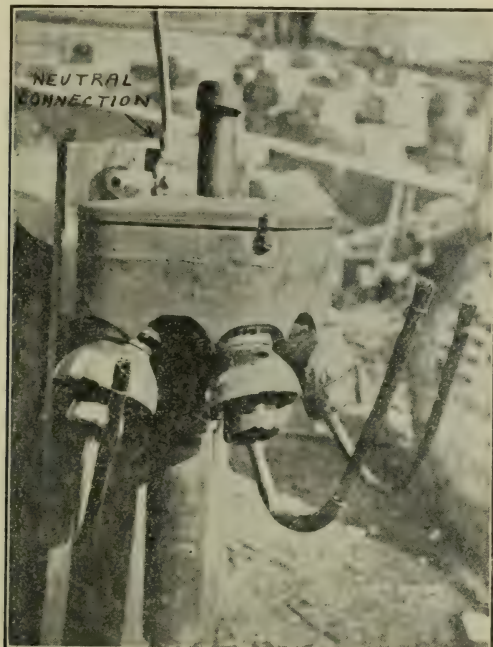


Fig. 11—Method of Connecting Common Neutral to Cable Sheath at end Bell.

In operating this grounded common return system the first requirement after erecting the pole line is, of course, the running of this common return wire. For all ordinary cases of local distribution a wire of the equivalent of No. 4 copper is ample in size. From an operating standpoint it should be insulated with regular weatherproof insulation and supported on glass insulators if wooden poles are used and high tension wires are on same poles. This is not to insulate the return wire, which electrically can just as well be bare, but to prevent linemen working on the poles and handling high potentials coming in contact with the grounded conductor. An insulated wire is also of some benefit if a high potential wire falls over it, that is provided the other wire is also insulated and potential to ground does not greatly exceed 2,300 volts. In other words, for potentials up to 4,000 volts delta use insulation on all lines, and above this point omit insulation on the high

potential and do not depend on it as a protection against crosses between the high potentials and the adjacent low potential circuits. Insulation which is not a protection is a death trap, and its omission is both a safeguard and an economy. This common return main must, as already stated, be permanently and effectually grounded. This condition can be obtained only by attaching to an underground piping system at a number of points. Fortunately, but few towns of even small size are to-day without their local water supply systems, and even the farmers quite generally have their own piping systems leading from a well to the various buildings. This makes it comparatively easy to get good ground connections.

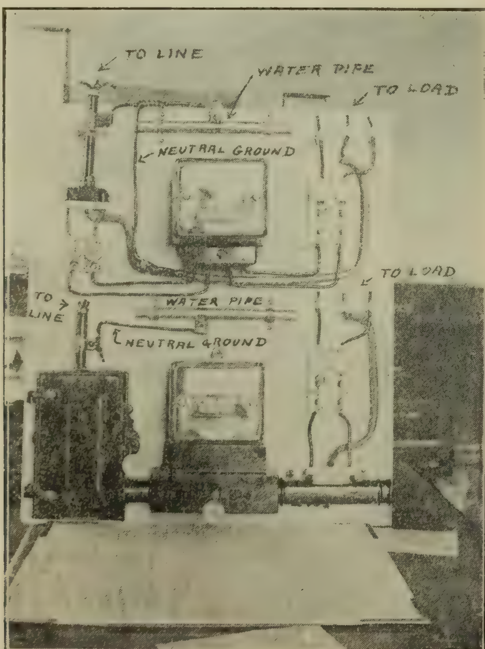


Fig. 12—Neutral Grounded Connections. Open Service shown in upper part of Cut and Sealed Service below.

In introducing services good practice demands some form of sealed service box in order to prevent theft of current and prevent the consumer inserting service fuses dangerously large for his installation. This makes it imperative to enter the building through conduit, and the natural place to enter in this manner is the basement or ground floor. The fire underwriters require these conduits to be grounded to a piping system, and, by so doing, have made it very easy for us to get our common neutral grounded at every conduit service at a cost of but a few cents each. The process consists simply of placing a jumper between the conduit ground wire and the service wire which

Fig. 13—Four Wire Common Neutral System.

Fig. 14—Single Primary Fuse Block.

connects to our common return on the pole. This may be done at the service cutout and requires but a few inches of wire and a few moments of time (Fig. 12). The various distribution neutrals should be cross

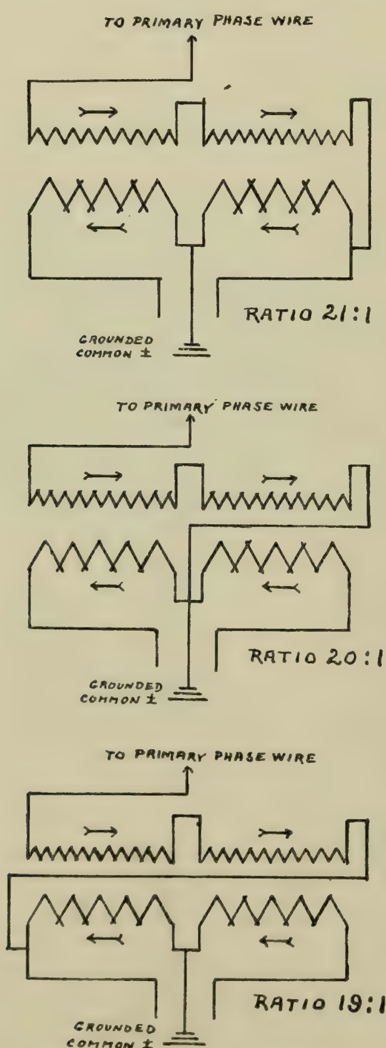


Fig. 15—Variable Ratios from Standard Lightning Transformers.

connected as often as possible in order to form a series of neutral rings throughout the system. This makes it impossible to open the neutral or leave it unprotected by grounds, and, incidentally, permits

of economic utilization of a cross section greatly in excess of that on any one street.

Transformers connected to this common return system are of the usual standard type, stepping down from 2,200 to 110/220 volts. The primary supply requires, however, but a single wire, which can advantageously be attached to an insulator on steel pin placed directly in top of pole. This type of pole construction, using a three-wire secondary main supported on steel vertical bracket, makes an unusually

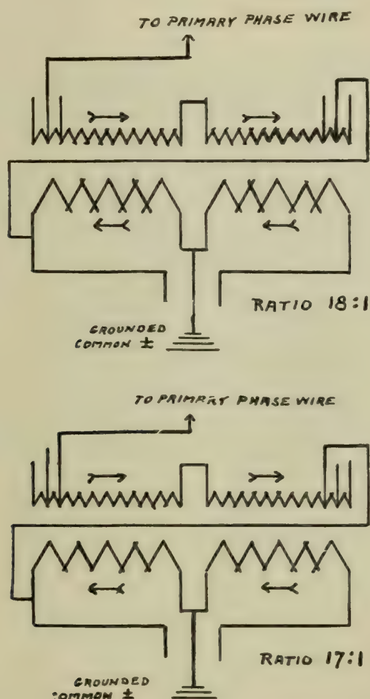


Fig. 16—Special Ratios with Transformer having 5% and 10% Taps.

neat, as well as economical, design (Fig. 13). In making extensions the three-pin secondary bracket is installed throughout the run and the common neutral placed on centre pin. The outer wires of secondary are then extended both ways from the transformer as required, and, when they meet, are interconnected. This makes possible a secondary distribution interconnected throughout even in new districts, the rule to apply being to extend secondary beyond the primary, or in preference to installing additional transformers up to the point where the annual charges for outer wires of secondary system would equal the fixed charges of an individual transformer, giving careful consideration

to the point that copper wire has a well fixed scrap value on which to base depreciation, whereas a transformer may last two years and may last twenty.

In connecting the transformer for standard ratio of 10 and 20 to 1 but one primary lead is used, being protected by a single pole fuse block (Fig. 14). The other end of primary coil is connected inside the case to the neutral secondary lead. This connection may, of course, be made outside, but it is neater and better if made inside. This same transformer may be connected to either boost or crush 5 per cent. by simply tapping the other end of primary to one or the other outer leads

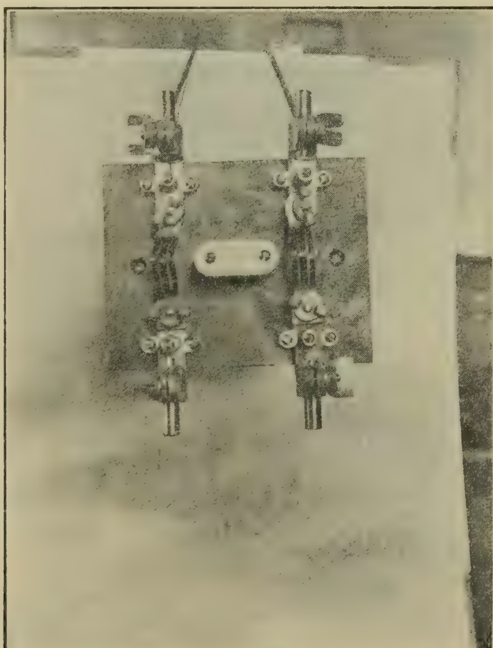


Fig. 17—Transformer Secondary Fuse Block. For Method of Installation see Fig. 14.

of the secondary instead of the neutral. This gives, when connected to boost, an increased capacity of 5 per cent. The ratios thus possible to obtain without primary tappings are 19 : 1, 20 : 1, and 21 : 1 (Fig. 15). For transformers regularly supplied with 5 and 10 per cent. taps additional ratios of 17 : 1 and 18 : 1 (Fig. 16) may be obtained. This makes an ideal system for suburban distribution, as the transformers in various towns may be so connected that their ratios bear an approximate relation to their distance from the main generating station, and fair peak load regulation should be possible without individual feeder regulators, bus regulation being used entirely. For first class distribu-

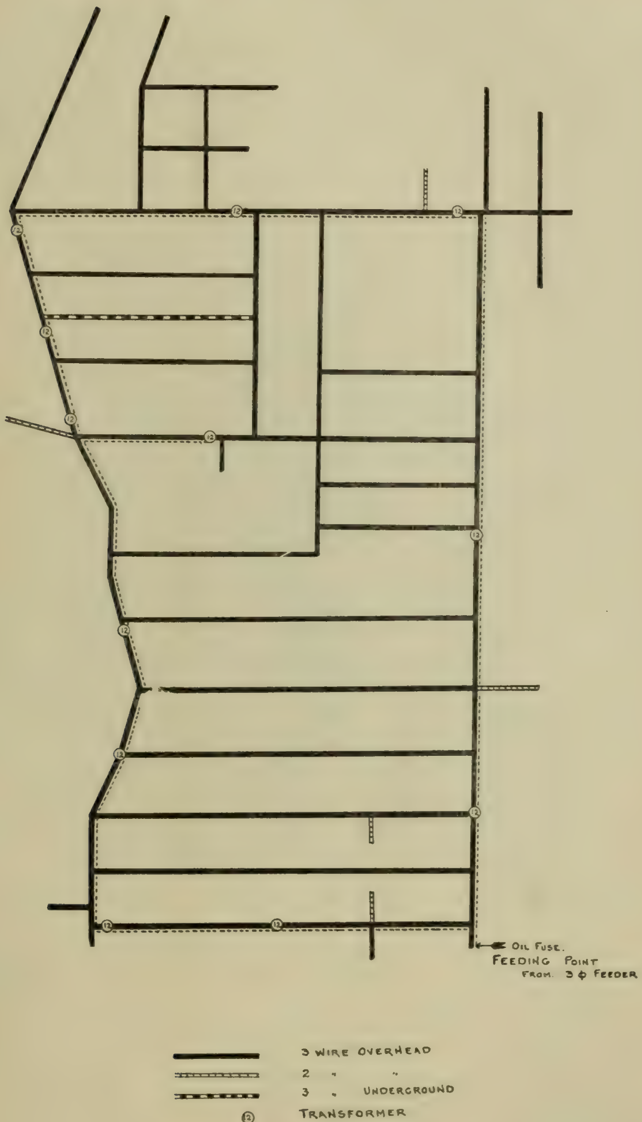


Fig. 18—Typical Secondary Network.

tion, however, the automatic induction regulator for each feeder is the only solution. These are fairly expensive, but their cost is well warranted by the results obtained, particularly in the case of a feeder supplying several small towns or separate load centres. For a single

feeder this condition requires very heavy wire between the load centres in order that the difference in primary pressure may be very low. This frequently makes it necessary, where local regulation is not used, to run separate feeders to each centre. With an automatic regulator installed at each load centre absolutely uniform pressure may be obtained in every town, even if several are supplied from same feeder. The local substation need be but a small building and requires very

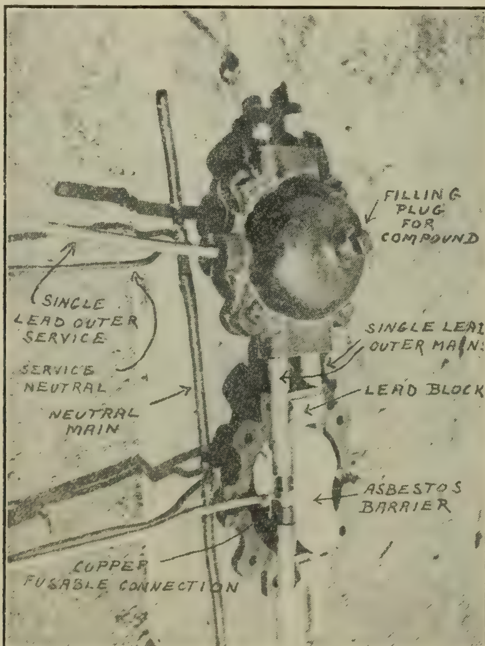


Fig. 19—Underground Service Boxes. Solid System with Grounded Neutral.

little attention, a visit once per week to clean and inspect the regulator contacts being all that is required. This plan of supplying each load centre from a small substation is of further advantage in that automatic protective devices may be conveniently installed here to cut off this particular section in case of trouble. The regulator is supplied by its own potential and current transformers, and a single phase 5 ampere integrating secondary wattmeter may be installed on the same transformers, thereby measuring at very small expense all the current delivered to this particular section. This is of particular benefit to both the distribution and commercial departments, as it enables them to check up the line losses and also the revenue obtained from any one load centre or district.

In selecting the size of pole transformers and the type of secondary distribution, local conditions must be studied carefully. Unless the

load is very badly scattered, relatively large transformer units feeding a large interconnected secondary network makes the most economical as well as most reliable system. Transformers may be confined to three sizes, 5, 10, and 15 K.W., the latter used for large concentrated loads and for feeding the networks. The small size will be found useful in

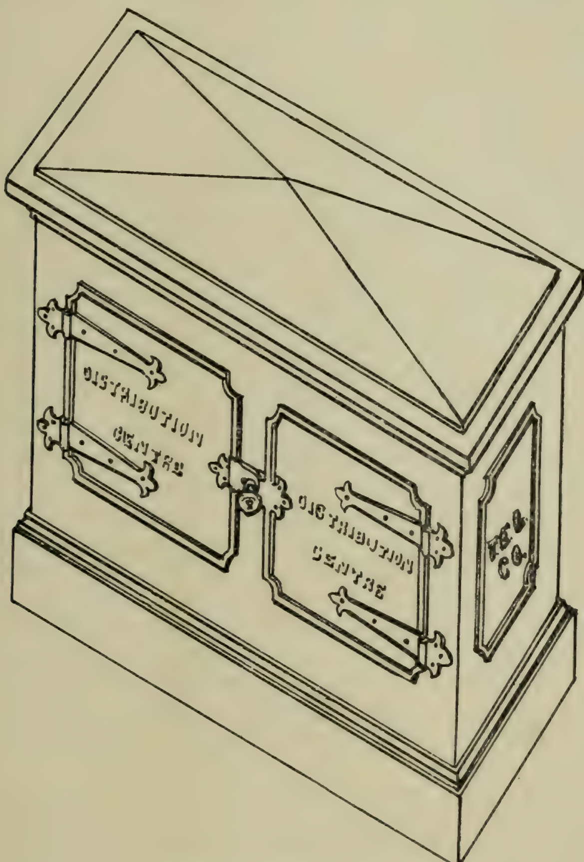


Fig. 20—Junction or Pillar Box.

feeding isolated loads and to help out the tail ends of a network while the business is growing, being changed when load conditions warrant for the larger size. The intermediate size will be found useful in networks of moderate size, as not less than three transformers should ever be interconnected, and small villages will frequently not warrant the installation of three 15 K.W's.

The outer secondary leads of all transformers should be protected with low tension fuses (Fig. 17), the neutrals, of course, being con-

nected solid. In networks a fuse may also be inserted in the mains half way between transformers; in fact, this is necessary unless the primary feeding the network can be disconnected in case of trouble. Unless this is done the transformers banked can not be re-fused if they blow out under load. In large networks the better practice is to connect solid and depend on the heavy current available to burn off faults, etc. Just a word of caution, however, in regard to these secondary fuses. They are exposed to the weather and an ordinary lead and copper tip fuse will disintegrate. Use cast brass or copper contact posts and wing nuts and copper fuses. A plain copper wire supported on about four-inch centres makes an ideal fuse for exposure to the weather. No. 18 B. & S. gauge will carry about 100 amperes, No. 16 150 amperes, and No. 14 about 200. An ideal distribution is shown by Fig. 18.

In high class suburban districts occasional demands arise for underground distribution. This can be cheaply and reliably handled by simply laying the cables solid in the earth, covering them if desired with a treated plank to prevent mechanical damage. The common neutral may be a bare copper wire or plain weatherproof insulation. This type of construction for secondary distribution does not greatly exceed the cost of a first class overhead line when upkeep and replacement costs are considered, and, being laid usually under unpaved streets or grass plots, can be opened up for repairs or extensions at minimum cost. Service taps are taken off through a small cast metal box enclosing the joint and afterwards filled with compound (Fig. 19). The actual tap is usually made through a single strand of copper wire which will fuse under short circuit conditions and disconnect the defective service. If single branches are made the box should be of non-magnetic metal, to avoid inductive effects. If made of cast iron the box must enclose all wires of the main, and these must enter through a non-magnetic bushing. Lead makes the best metal for this purpose. On extensive underground networks junction points should be sectionalized in a pillar box placed near the curb at intersections. These would have somewhat the appearance of the ordinary stone carriage steps which used to be so common and do not constitute an eyesore to the general public (Fig. 20).

It must be self evident that a system on the foregoing lines can be installed with less upkeep cost than former methods, and, having fewer parts to cause trouble, must perforce be more reliable. As to just what savings are possible that can only be determined by figuring actual cases; this saving is, however, very considerable, as has been proven by actual operation of such a system.

Mr. A. B. Lambe: Mr. Hood speaks of vertical line construction, in connection with which it might be stated in justice to Mr. Fiske, of Peterboro, that he was probably the first man in Canada to construct that form of line. He did a great deal of it in that city, and it had a most satisfactory appearance. Mr. Archibald of Woodstock, I think, is also doing it, as is Mr. Austen in Toronto. Mr. Hood speaks also of the

question of joint poles. That is a most important point, and one wherein we are scandalously wasteful, in my opinion. We can see an illustration of this right in this city, to say nothing of other places where the city has spent unlimited money in putting in standards when they might have kept the streets comparatively clear and could have done the same work for, say, a third of the money, by making an arrangement for joint use of the iron poles of the street railway. It meant simply bolting a bracket onto the iron poles once you had arranged for joint use. Then I would like to ask Mr. Hood and the other gentlemen here whether or no they advocate grounding right in the house to some of the water pipes that are there? Turning to page 19, at the bottom of the page, Mr. Hood says you can do some transferring when a line is grounded. The point that worries me in connection with this statement is that instead of going out and disconnecting several hundred services and transferring them to another wire, would it not be quicker and cheaper to find the ground and remove it. At the top of page 20 Mr. Hood says that the motor and lighting circuit neutrals should be interconnected, in order to ground the former. Now(that motor circuit might be 550 volts, which means grounding something in the neighborhood of 350 to 400 volts, which, as far as I know, is somewhat beyond the recommendation of the latest committees that have been investigating grounding. I would like to hear Mr. Hood discuss that point. Then, on page 33, Mr. Hood states that you can lay a power cable solid in the earth, and then says "the common neutral may be a bare copper wire or plain weather-proof insulation." What good will plain weather-proof insulation do?

Mr. L. B. Chubbick: Mr. Hood has brought up a point about the three-phase wire connection, and I think it may be interesting to know how very easily you can get that in some cases from the standard 2,300-volt star. Referring to the practice of transfer stations by electric power companies, it was found quite easy to arrange these for initial operation of 2,300 volts, and change over to 4,100 volts, with, possibly, an hour's work in the station. In the generating station it is not quite as simple a problem. The generators may be so designed that we can simply reconnect them with a star connection, or it may be necessary to re-wind them. If the feeders which we wish to run on 4,000 volts are of small capacity it may be practical to simply instal a small three-phase auto transformer in the station. Another plan is to instal a four-thousand-volt star connection generator, and, if advisable, operate this in parallel with the rest of the station three-phase auto transformers. In regard to switching, any substantial 2,300-volt oil switch will handle the 4,000-volt star connected circuits of corresponding capacity very readily. In regard to protection, the standard double pole relays and fuses, with three series transformers, will give ample protection for all four wires, so that in a great many cases the plants which have now adopted a 2,300-volt delta can very easily make the change to 4,000 star at very little expense.

Mr. Mudge: I have a contribution on this subject written by Mr. F. T. Stocking, which I will read:

COMMENTS ON MR. S. B. HOOD'S PAPER "THE CONSTRUCTION OF DISTRIBUTION SYSTEMS FOR OUTLYING DISTRICTS AND SMALLER PLANTS" FOR 22ND ANNUAL CONVENTION OF THE C.E.A.

By F. T. Stocking.

June 18th, 1912.

The paper is an exceptionally good one and the subject has been treated in a thorough and practical manner, but there are a number of points to which exception might be taken.

Among the first of these is the use of Western cedar poles. These poles have considerable advantage over our Eastern cedar, in that they are very straight and uniform in size, which characteristic, together with the fact that they are much slimmer than the native poles, gives the line a neat appearance and reduces the labor costs to a minimum. These conditions fully justify the use of Western cedar in thickly settled localities when appearance is of prime importance, but in outlying suburban districts these advantages are not so marked. Here the line is more exposed to weather conditions while the more scattered load will not permit of a too expensive line; consequently for this class of work the native cedar is much more suitable. For suburban work comparatively short poles may be employed, and these of good quality are still to be had in the East in almost any number. The larger diameter at the butt compared with the Western stock gives them a strength about double the latter, which is of considerable advantage, especially in the more exposed locations found in suburban work. For the same reason, if no other, the life is much greater and it is believed that Eastern cedar will rot less rapidly in our soil and climate than the Western stock. The cost of labor when using Western is somewhat less than with the native pole, but this is more than offset by the greater first cost of the pole itself.

The figures for a 30 ft. pole would be about as follows:

Cost of 30 ft. pole 7 in. top shaved, framed, erected, stepped and painted, but not treated $10.00
Life of pole, 15 years.
Annual cost with interest at 5 per cent. 1.17
Annual saving over a treated Western pole .... .52

Probably the greatest advantage of the native pole for suburban work is its greater strength and reliability, a fact which is sometimes lost sight of. When the stock is carefully selected the appearance is little inferior to a line built of Western poles.

The remarks on concrete poles are very much to the point since it is certain that these poles as ordinarily designed will not stand up under

some of the strains to which they may be subjected. When the importance of the work will permit of a design generous enough to withstand the greatest possible strains with a fair factor of safety, the concrete pole is without doubt a good one as it is practically indestructable and requires no painting or other care.

Pole Fittings and Hardware.

There is little doubt that the treatment of crossarms with a good preservative is a paying investment if these are mounted on poles with a life longer than 8 years. The same remark applies to the galvanizing of hardware, the object being to give all material which goes to make up a line as nearly as possible of the same life. The cost of erecting is so great, that, generally speaking, it does not pay to renew one portion alone. On the other hand, for suburban work in a growing locality it is not always wise to spend too much money on preserving the life of material since conditions, such as the growth of trees, the changing of street grades, the changing of position of walks and curb lines, and the increase of load may necessitate the rebuilding of a line before the natural life has been spent.

With regard to pins, it is remarkable that up to the present time no pin has been designed which is really satisfactory for the heavier class of distribution work. For wire up to No. 4 the locust pin will usually hold if double arms are used, but for wires larger than this, the factor of safety becomes exceedingly small. Heavy cast pins under changes of temperature cause breakage of insulators, while very few of the other types will withstand strains of one-quarter the breaking strength of the larger wires commonly used without either bending or breaking. This necessitates the use of strain insulators on corners of heavy lines which construction is awkward and comparatively expensive.

With regard to the clamp pin mentioned at the bottom of page 13, these are very good provided the centre of groove on the insulator comes opposite a point from ⅝ in. to ⅞ in. below the top of pin, since otherwise the insulator will tilt giving unsightly as well as unreliable construction. On corners the pin itself has a tendency to slide and tilt on the arm, and it is necessary to fasten it in place by means of additional bolts. On straight dead ends this slipping does not occur.

On page 15 in connection with side bracket construction is mentioned a method of dead ending secondary wires by means a 3-spool insulator bracket. A method slightly better in some respects is to use a fork bolt with spool insulator similar to that mentioned on page 13. These are put directly through the pole, giving exceptionally strong construction with no torsional strain on the pole, and have the further advantage that the tension can be adjusted on separate wires by tightening or slackening the bolts.

Distribution Systems.

The question of joint pole constructors is becoming of greater and greater importance, and should be recognized by all companies as a very desirable, if not necessary, form of construction.

There is coming to be such a multiplicity of poles and wires on our streets that they form a constant menace to linemen and an eyesore to the public. Joint lines properly erected on suitable poles minimize the danger of accident and give a decidedly improved appearance. As shown in Mr. Hood's paper, the maintainance cost is less, but if this were not the case the better appearance given would justify this form of construction, especially at this time, when the public is objecting so strongly to overhead construction.

The four wire system with grounded neutral has very deservedly been given a prominent place in this paper. Not only does it materially lessen the cost of wire on the distributing system, but occasionally avoids the necessity of a step down transformer station, permitting as it does the use of standard 2,200 volt transformers on a 4,000 volt system.

The method of using auto transformers as described in Mr. Hood's paper, no doubt, results in considerable economy, but to use it safely in connection with secondary circuits considerable care would be necessary in making the grounds.

It would not be safe to depend on less than two, or better, three grounds, each one of which should be practically perfect and capable of continuously carrying a current well above any primary current that could be maintained on the section of line in question. These grounds should also be frequently and systematically inspected, and when one is found defective it should be immediately repaired. To depend on three or four grounds as usually made inside buildings and which are never inspected, would appear an unwise practice. Where the number of such grounds on a single secondary system reaches 10 or more, no doubt all likelihood of trouble would be removed.

"THE CONSTRUCTION OF DISTRIBUTING SYSTEMS FOR OUT-LYING DISTRICTS AND SMALLER PLANTS."

Contribution by L. B. Chubbuck.

The advantages of the 4,000 volts, star system, with 2,300 volts to the neutral for certain plants, has been very clearly brought out in Mr. Hood's paper.

It is interesting to note how readily this 4,000-volt system may often be obtained by a very slight rearrangement of standard 2,300-volt delta apparatus. Our Company recently furnished the equipment of a number of transformer sub-stations designed for initial operation at 2,300-volt delta and future operation at 4,000 volts star, and it was a very simple matter to arrange the apparatus so that there would only be a matter of a few moments required to change from one to the other system.

In the case of a generating station the problem is not quite so simple. In some cases the generator armatures simply require re-connection; in other cases re-winding may be necessary. In case there may be only a small capacity of long feeders desired to operate at 4,000 volts, a small three-phase transformer or auto transformer can be installed to take care of this load. Another method is to instal a 4,000-volt generator and parallel this with the rest of the plant through a transformer.

In regard to the switching equipment, any substantial 2,300-volt oil switch will handle the corresponding 4,000-volt star connected circuit. It is not customary to open up the neutral connection, this being run solid from the star point of the transformers (or generators as the case may be) direct to the line. Regarding the automatic protection of feeders, the standard double-pole relay with three series transformers will give complete protection. This may mean the addition of one series transformer per circuit, which, however, is a simple matter.

Mr. Mudge: With further reference to joint pole construction, I think a good deal more of this might be done than is done at the present time. I have in mind a town in Ontario of three or four thousand inhabitants where a year or two ago there was a line of the Bell Telephone Company's poles on one side of the street in pretty good shape. On the other side of the street the Electric Light Company had one line of poles in pretty bad shape, and the G. N. W. Telegraph Company had a line of poles in fair shape. The Electric Light Company had to rebuild their line; so they got in touch with the telephone and telegraph companies, and also with the town authorities, and an arrangement was finally made by which the poles on that side of the street where the Electric Light company and the G. N. W. Telegraph Company were placed were taken

down and replaced by one line of forty-five-foot poles. The G. N. W. circuits were run along the top of these poles, and the Electric Light company ran their secondary wires lower down on the poles. If I remember rightly there were no primary lines run on that street. The transformers were put at the various street corners. An arrangement was made with the Bell Telephone Company by which the Electric Light Company's secondary wires were carried on their poles, and two light fixtures were put on every second pole of the telephone line and on every second pole of the combined G. N. W. and lighting company's line on the other side of the street, giving two 75-watt Tungstens about every one hundred and twenty-five feet along the street. That was on the main street of the town, and it has improved the appearance of the street very much. The town bore part of the cost of doing the work, and the Bell Telephone Company are paid a rental of $1.50 a year per pole for allowing their poles to be used. In accordance with the usual practice of the Bell Telephone Company, their poles were painted. The new line of poles on the other side of the street were painted. Having the 110-220-volt secondary circuits on both sides of the street made it unnecessary to cross the street with service wires. The result in general has been very satisfactory, and I think that similar work should be done to a very much greater extent than is done at present.

The longer we delay co-operation of this kind the sooner will we be forced to place our wires underground, which, although generally admitted to be advisable to a greater or less extent in the larger cities, is not yet commercially practicable in the smaller town and outlying districts.

I would like to ask Mr. Hood something further about that Avenarius carbolineum—as to how long it has been used and what the record has been as to its protecting pole butts. In regard to the auto transformers, I think they will have a very much larger use in the future than in the past. On page 24 a question is brought up about using a neutral wire and insulating it. If the neutral wire is used it, of course, can be put right up at the top of the pole, and in that case a bare wire would be satisfactory. With regard to twenty-five-cycle lighting, I think the paper speaks perhaps a little more strongly in favor of twenty-five-cycle lighting and of its being more satisfactory than the actual facts appear to bear out. Mr. Hood states that if you get up to twenty-seven and a half cycles the vibration disappears, but I know that claims have been made that there are injurious effects to the eye in connection with low frequency lighting in spite of the fact that the eye does not detect it and that a higher frequency is very much more satisfactory so far as the effect on the eye is concerned.

Mr. McDunnough: There is one point which might perhaps be of interest to construction men. During the last few years our Company has been using a square pin. It is a square shank pin which is bolted to the face of the cross arms. You see there is no chance of interior rotting of the cross arms. In regard to the thirty-cycle lighting, our fre-

quency is 30-cycle, or 30¼, and we have been distributing lighting on that for the last ten years, and there has been no complaint in regard to that. In connection with common pole lines, I have in mind one village we are lighting where there are four pole lines on the main street, the G. N. W., the Electric Light, the Bell Telephone and the village telephone. We have tried to get them all together and make one common pole line, but we cannot get them together at all.

Mr. Hood: (closing discussion): With respect to the question of making the grounding connection in the house, I say most emphatically that is the place to put it—right in the basement of the house. That means bringing your service in at the basement. While it might be very convenient to bring in a house service in a man's bedroom or in the attic, there is no question that if there is a basement, the basement is the place to bring the wires in. You never hear of the gas companies coming in in the attic. Under natural conditions they have put their meters in the right place, and that is the place for us to put ours. Of course, where the common practice in the town is to come in overhead it is pretty hard to change, although it can be done gradually if the thing is taken up systematically.

To my mind there is no use running a ground wire down the outside of the house, as mentioned in the National Electric Code, to get into the basement and down into the water pipe. When you have already carried the service into a tube and down into the basement what is the use of carrying another line down the outside when you have one inside already?

As for the question of transferring a defective three-phase circuit from one phase to the other two good ones, when I speak of that I mean where the feeder is carried out as a three-phase, four-wire feeder to definite centres from which point a single-phase, primary distribution for the secondary network is taken off; in other words, a feeder made with three or multiples of three distributions. Each one of these distributions forms its own single-wire primary system, the return wire being the common grounded neutral. If a phase cuts out in the ordinary circuit, you have only three single-phase lighting distributions (one on each of the phases), and it is simply necessary to cut a jumper and tap over onto a worring phase. If you are feeding a town ten miles away from the plant it takes quite a while to go over that ten-mile line to see what has gone wrong with the wires. Let your man jump over the single-phase distribution with three or four feet of wire and it is quite an advantage.

In using weather-proof wire for the neutral on overhead work, if the ground wire, as Mr. Mudge said, is put up high out of reach, there is no use putting the insulation on it. In the underground work I mentioned it was not weather-proof wire as a general thing. Around a plant you have lots of weather-proof scrapping, and if you are going to use it there is no use in taking a knife and scraping it off. We find that is a very good way of using our scrap.

In reference to operating this grounded neutral system with two or three, or considerably more grounds, it is not a safe proposition. If you are going to undertake it, you must ground every service right to the water pipe. I wouldn't trust it with a dozen grounds. On this system we have in Toronto in the neighborhood of four or five thousand customers. It is not very much compared with the total load, but it is enough to know whether it is going to work or not. Some of these have been in operation for two years, and practically all of the four or five thousand customers have been on for over a year. Previous to that time we had no end of trouble from crosses with higher potentials, crosses by trolley lines and crosses of every other kind. Added to this, another system, our competitors, seemed to have a faculty of getting their lines tangled up with ours, and making further trouble. Now, it seems to me the other fellow gets the worst end of the stick wherever there is a cross. Our system is protected, I suppose, by about fifteen hundred ground connections. As our standard practice is to bring it into the basement and put the meter there, each one of these ground connections simply represents a wire connection of possibly about 18 inches long, so the 1,500 grounds do not represent any great amount of work in that case. Take a system where all the services go in upstairs: if you had to run fifteen hundred grounds down the outside of the building it would be quite expensive. At the same time, if you consider only your single-phase primary distribution, by putting on these grounds you can take down one of your wires and you will come out at the good end of the game, even if you have to run it all the way down from the attic.

As to the use of carbolinium, my experience with that goes back eight or nine years, and it has been very successful. I believe Avenarius is the trade name for the original carbolinium. They have had quite a number of tests, and you can get a copy of the reports by sending to the makers. These reports I think have been made with the authority of the United States Forestry Bureau and several other reliable societies, and it takes the report away from a pure advertisement, and shows there is merit in this method of treatment.

Mr. Mudge: While you are on that subject, would you consider it at all feasible to treat poles that were already up?

Mr. Hood: No, treating wet timber is, I think, a waste of money. Of course, when it is in the ground it is soaked.

Mr. Maclachlan: Is there any vacuum process used, or is it just painted on?

Mr. Hood: Painted, I think. You can treat pretty wet poles and get fair results.

Mr. Lambe: One other point about grounding in the house, as the Electric Inspection Act is a little peculiar in its word. One clause says that where a ground exists that may be "a source of leakage" it must not be there. I don't know whether you would call an ordinary ground a source of leakage or not, but if you do it cannot be there, anyway. House grounding is illegal, as I read the Act, by the next clause, which

prohibits any connection with the earth that has a resistance of less than 5,000 ohms.

Mr. Hood: I do not think that is the intention of the Act.

The President: I think if current was leaking from a wire through a fault it would be a ''leakage.'' When they speak of ''leakage'' they mean the leaking through the insulation or where the insulation ought to be. This discussion has been very interesting, and I regret that we cannot spend more time on the subject, but the paper will be published in the proceedings and we can study it later on. Sometimes the best results are obtained from reading the papers after the Convention is over carefully and at leisure.

The hour being late, the Convention adjourned till the following morning at nine o'clock in the Family Theatre.

A photograph of the members was taken in front of the Parliament Buildings.

EXECUTIVE SESSION.

At 2 o'clock p.m. a meeting of the Executive (Class & and B. members) was held, the President in the chair.

The first item of business was the reading of the Minutes of the last meeting. It was moved and seconded that the Minutes be taken as read. The President put the motion, which, on a vote being taken, was declared carried.

The President: There is a matter which has come up which I might explain briefly. Mr. Chambers, who is managing an electric light plant in Truro, Nova Scotia, has written a long letter complaining bitterly of his treatment by the Public Service Commission of that Province. He says they have discriminated against him and compelled him to adopt rates much lower than those of other cities in the Province, and so on, and he wishes the matter to be laid before you. Some of the members of the Managing Committee have considered the matter and we believe that Mr. Chambers is very much to blame himself in not having sought the assistance of this Association through its officers at the time when he was in trouble. We could then have furnished him with expert evidence with which to go before the Commission, and which might have influenced the Commission. He might have been helped also in other ways, but he did not do anything in that line until his position was serious. His only chance now is in getting the Commission to re-open the case. The Secretary might write him to the effect that if the Commission will re-open the case and he will let us know at once, we will try and help him.

It was moved by Mr. Pack, that the Secretary be instructed to write Mr. Chambers as indicated, and that the whole matter be referred to the incoming Public Policy Committee. The motion was duly seconded and carried.

The President: There was one other matter I wanted to speak of. As many of you are aware, at the last session there was some legislation brought before the Ontario House, and your Managing Committee took the matter up and invited all the companies in the Province of Ontario to co-operate with them. We formed a very strong delegation and met in Toronto and interviewed the Hydro-Electric Commission and members of the Government. We got some little changes in the wording of the amendments which take away some of the sting, but the Government evidently was determined on making some changes and we could not do much. Nevertheless, there was the organization and the means of getting together quickly, and that is something. We were able to go before those people and tell them we represented many millions of capital, and so forth, and on some other occasion we may be more successful.

Mr. Pack: Just before I left home the Board of Fire Underwriters asked me to bring a matter before the Convention. It appears that in a recent Act of the Province of Ontario the Hydro-Electric Commission were empowered to draw up regulations regarding wiring and so forth. Now, so far as the underwriters are concerned, I do not know that we need worry ourselves, but they seemed to think that this Association should try and bring some influence to bear on the Hydro-Electric Commission so that they will not simply undo a great deal of work that has already been done, and so that their regulations will be in conformity with what is now almost an international code. I would suggest that it should be referred to the incoming Public Policy Committee.

The President: I am very glad Mr. Pack has brought this up, because it is really important. The Hydro-Electric Commission has no doubt the power to regulate these things and their intention is, I understand, to make them uniform throughout the Province and where a municipality appoints a local Commission it will be governed by the rules laid down by the Hydro-Electric Commission, and if these happen to be different from those of the underwriters there will be two sets of rules to bother with. I think we ought to confer with the Hydro-Electric Commission as they will no doubt see at once the advantage of having one single code. That code has been so thoroughly threshed out that I do not see why they would not adopt it. It is the result of many years of experience.

It was moved by Mr. Bird, and seconded by Mr. Kemble, that the incoming Managing Committee be instructed to deal with this matter. The motion was carried.

The President read a telegram from Mr. Samuel Insull, of Chicago, regretting his inability to be present, and hoping the Convention would be a great success.

The report of the Nominating Committee was presented by Mr. Kemble, who stated that the following were the nominations for the next year:

President, R. F. Pack; 1st Vice-President, W. L. Bird; 2nd Vice-

President, R. H. Sperling; 3rd Vice-President, J. S. Norris; Hon. Secretary, T. S. Young.

Managing Committee—A. A. Dion, W. C. Hawkins, A. L. Mudge, H. G. Matthews, W. L. Adams, F. A. Chisholm, I. H. Wright, D. R. Street, P. H. Kemble, Wills Maclachalan, D. H. McDougall, E. L. Milliken, H. B. McDunnough, W. Phillips.

"The Managing Committee are extremely anxious to be able to have Mr. Young's experience and counsel on tap, if I may be pardoned the slang, when they need it. The Nominating Committee have, therefore, consulted him and now propose that he be given the position of Honorary Secretary, a permanent secretary or an active secretary to be appointed later by the Managing Committee."

Mr. Bird: I would like to suggest that Mr. J. S. Norris' name be put down in place of mine for the position of Vice-President.

The President: As far as I have been in touch with the Nominating Committee I know they have considered these matters very carefully and I think this should be left as they have put it.

It was moved by Mr. Matthews, and seconded by Mr. Mudge, that the report of the Nominating Committee be received and that the Secretary be instructed to cast a ballot for the election of the members named by the Nominating Committee.

The President put the motion, which, on a vote being taken, was declared carried, and a ballot was accordingly cast.

Mr. Pack: I should like to express my great appreciation of the action of the Nominating Committee and express my thanks for the great honor that has been conferred upon me. I feel it is a very great honor. I think that those who know me best know that I have the interest of the Association very much at heart, and so I trust that you will all feel that I shall do everything I can to carry on the old traditions and make the Association successful in the future. Of course, one man cannot do everything, and I want to ask the individual members of the Association to give me all the support they can and to do what they can to influence other companies to come in as members. I think there are only forty-eight operating companies now members of the Association, and as the strength of the Association depends on the number of its member companies, it is of the utmost importance that a great effort be put forth this year to induce other companies to join. So I ask that every member of the Association do what he can before the year is closed to bring in at least one other company. I want to thank you very much, indeed, for the very great honor you have conferred upon me. (Applause.)

Mr. Bird: I do not want this opportunity to pass without moving a very hearty vote of thanks to the presiding chairman who is passing out of office. I am sure he has had a very hard year's work for the Association, and a great deal of thanks is due to him for his continued interest and energy, which has culminated in one of the most, if not the most successful Convention, in the history of the Association.

Mr. Kemble: It gives me very much pleasure to second that motion, and also to call attention to the remark made by the President during the opening session which I do not think has sunk in as much as it should, to the effect that the entertainment of the Convention here is entirely a local gift and does not in any way come as a tax on the Association's funds. I think that is merely one of the many evidences of the interest that our retiring President has taken in the Association. (Applause.)

The motion was put and declared carried.

Mr. Mudge: I should like to congratulate the Nominating Committee on devising the scheme by which Mr. Young's services have been retained. (Applause.)

Mr. Kemble: I should like to be able to stagger under the weight of those congratulations, but the suggestion came from a member of the Managing Committee. The Nominating Committee can only take credit for pushing it along.

It was moved by Mr. Pack, and seconded by Mr. Webber, that the usual honorarium of $500 be granted to the Secretary for the past year's services.

Mr. Young: I am speaking very seriously, and I would like to suggest that you withdraw that motion. The expense of the work during the past year has been considerable, and the Association is not in a strong financial position, and I have not been able to give as much time to the work as I should perhaps have liked to do. While I thoroughly appreciate the motion that has been brought before the meeting I think that if the Association would make me a grant of $100 or $200 to cover my expenses in connection with this Convention and a few incidental expenses, it would be sufficient, and I would suggest that the motion be made accordingly.

Mr. Robin Boyle: I would like to say that the honorarium that is proposed to be granted to Mr. Young aims to represent his services, not only during the past year, but services he has rendered to the Association during the many years he has acted in that capacity, and I think that even though our funds may be limited, it is our duty to show our appreciation for Mr. Young's services since he has been connected with the Association by voting the same amount that has been paid in the previous years. I am very much in favor of Mr. Pack's motion.

The President put the motion, which, on a vote being taken, was declared carried.

Mr. Dion: I just want to say one word in regard to the resolution you have passed. I have stated in my opening address my feelings in the matter, and I do not need to repeat it now. I feel that I have got more than my share of honors since I have been a member of the Association, and I wish to retire from now on because it is not fair for a man to hold office too long, and keep others out. I see that you have put me on the Managing Committee. I would have been as well pleased if you had not, but, in any case, I thank you once more for the confidence you

repose in me, and whether I am on the Managing Committee or not you can always depend on me to do my share whenever there is any work to do, if it is in my power to do it. (Applause.)

The meeting then adjourned, after which the Entertainment Committee took the members for an automobile drive around the city.

MORNING SESSION.

Friday, June 21st, 1912.

The meeting opened at nine o'clock in the Family Theatre.

President Dion: We will now resume business, and Mr. Baker, of the Canadian Westinghouse Company, will kindly read his paper on "Watthour Meters—Past and Present."

WATTHOUR METERS—PAST AND PRESENT

C. W. Baker

In 1831 Faraday built an electric machine which consisted of a square of wire so mounted as to rotate about an axis at right angles to the earth's magnetic field. The current was brought out to a two-part commutator and collected on two wire brushes. This machine delivered a very weak fluctuating unidirectional current which was detected by means of a galvanometer such as was then used to detect currents from batteries; battery currents having been known from Galvani's time some forty or fifty years previous.

Foucault Currents.

About fifty years later (in 1883) Foucault observed that a copper disc when rotated between the poles of a permanent magnet was retarded by the magnet, and also that the disc soon became warm; and so he discovered the existence of eddy currents in the disc. We now call these ''Foucault'' currents in recognition of his work. Practically all watthour meters of to-day have exactly this combination, a copper or aluminum disc rotating between the poles of one or more permanent magnets.

An Early Motor Meter.

Ferranti, in the same year, (1883) built a motor meter. An iron core was provided with a shallow cup, at the top, in which mercury was placed. A magnetizing coil, placed around the core, carried the current, which in turn passed into the mercury all around the periphery and passed out at the centre. When the load was connected, the core became magnetized, the magnetic lines of force passing up vertically through the mercury. The current, flowing radially in the mercury, was at right angles to the magnetic flux, and so caused the mercury to rotate. The cup was roughened so as to offer greater resistance to the motion of the mercury. The rotating motion was transmitted to an integrating train of gears by means of a small fan placed in the mercury.

Galileo Ferraris.

On March 18th, 1888, Galileo Ferraris gave the first clear enunciation of the principles of the rotating magnetic field, with which we are now so familiar in the induction motor and the induction meter.

Electrolytic Meters.

Electrolytic meters are fundamentally amperehour meters, and the charge for power is based on the assumption that the voltage of the

circuit is constant. St. George Lane-Fox was first to describe the electrolytic meter. Later Thomas Alva Edison developed his voltameter,—a shunted electrolytic cell in which 1/1,000 part of the total current passed through the cell; the rest of the current passed around by way of a low resistance shunt. A copper wire of a certain length and size was placed in series with the cell to compensate for the heating effect of the current in the cell. The amount of current, i.e., the Coulombs, or ampere-hours, was determined by the number of grams of metal that was carried from the Anode to the Cathode in the cell. It was a long slow process to bring in and weigh the two metal plates from each meter, and it is little wonder that the voltameter was soon discarded in favor of other and newer types of meters.

Commutator Type Watthour Meters.

The Thompson Recording Wattmeter, or watthour meter, as it should be called, is the best known commutator type meter. It was the prototype of all D. C. watthour meters, except perhaps those of the mercury motor and clock types.

A watthour meter is a motor generator set with a revolution counter to count the revolutions of the shaft. In commutator type meters, the motor (series coils and armature) is of the shunt wound type. (Using a series wound motor would give us an amperehour meter, not a watthour meter). The generator is the copper or aluminum disc rotating between the poles of the drag magnets and generating eddy currents within itself as discovered by Foucault (in 1883). The revolution counter is the integrating train of gears.

In designing a shunt motor, we make the armature resistance as small as possible, and the back E.M.F. as large as possible. In a meter the resistance of the armature circuit is so large that the back E.M.F. generated is entirely negligible. An appreciable back E.M.F. would cause the meter to run slow on overloads. These meters may be used on either D.C. or A.C. with about equal accuracy unless the frequency is very high. For 125 or 133 cycles, it is necessary to recalibrate.

For use on A.C. circuits of low power factor, a non-inductive shunt is placed across the series coil to compensate for the reactance of the armature.

The wound armature, the armature supports, the necessarily long shaft, the drag disc and the commutator make the moving element large and heavy. This, of course, adds very much to the friction and wear of the lower bearing—introducing a rapidly increasing friction as time goes on. There is also the variable friction of the brushes to contend with, giving a variable light load performance. Hence it has become the accepted practice to make light load check readings at 10% of rated capacity. For induction meters, this check is usually made at five or four per cent. of rated capacity.

Ampere-Hour Meters.

The first ampere-hour meters were of the electrolytic type. Then came Ferranti's mercury motor type mentioned above. About 1893 O. B. Shallenberger designed the well known Shallenberger Ampere-hour meter. This is an induction type meter. The current carrying parts are all stationary. The moving element consists of a shaft carrying a small aluminum disc with an iron ring around its periphery and a four-vaned fan mounted on the shaft below the disc to act as a brake or retarding device. The integrating train is similar to that used in modern watthour meters. A few ampere-hour meters are still in use in connection with watthour meters where a better rate is given for keeping the average power factor high.

From watthour meter readings, ampere-hour meter readings and assumed constant voltage the average P.F. is figured. This is a very rough method, and better methods are available.

Clock Meters and Oscillating Meters.

There are two types of meters which are decidedly interesting on account of their novelty.

The clock meter, made by H. Aron, Berlin, Germany, has two pendulums driven by clockwork. Each pendulum carries a shunt coil and below each pendulum there is a series coil. The polarity is arranged so that one pair attracts and the other pair repels. These forces, aiding and opposing gravity, cause the one pendulum to run fast and the other slow. The difference in the number of swings they make is registered through a differential gear which operates the dials. ''Creeping'' is prevented by reversing the direction of the clock-work every 10 minutes, and at the same time reversing the polarity of the shunt coils. This eliminates any errors due to the two pendulums having slightly different natural periods.

The oscillating meter (Electric Co., London) is novel in that its moving element oscillates rather than rotates. At the end of each oscillation a moving contact operates a solenoid which reverses the polarity of the shunt coil and so it starts back on the return trip and continues till it meets the contact at the opposite end of travel.

Alternating current is so universally used in this country and the induction meter is so rugged and so much cheaper than either of the above types, that they are interesting only in passing.

Induction Watthour Meters.

In the first practical induction type wattmeters O. B. Shallenberger placed his series coils in one phase and the shunt coil across the other phase of a two-phase system, using a non-inductive resistance in the shunt circuit. He also applied this meter in several different ways, as indicated by diagram in Figures 1, 1a and 2, Fig. 1 being a single phase meter, Fig. 1a being a polyphase meter, and Fig. 2 a single phase meter reading the power in a 3-phase circuit, assuming, of course, balanced conditions of load and voltage.

The outstanding feature of this meter (as of all induction type meters) is that the shunt current and series current are in quadrature for loads of unity power factor. This was a radical change from previous practice. Previous meters, being commutator type meters, had their shunt and series currents as nearly as possible in step for loads of unity power factor.

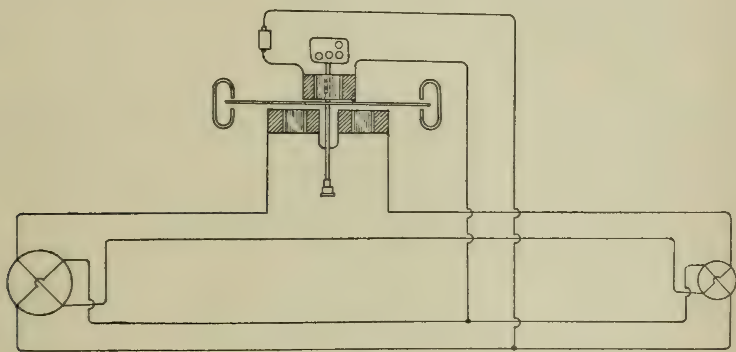


Fig. 1.

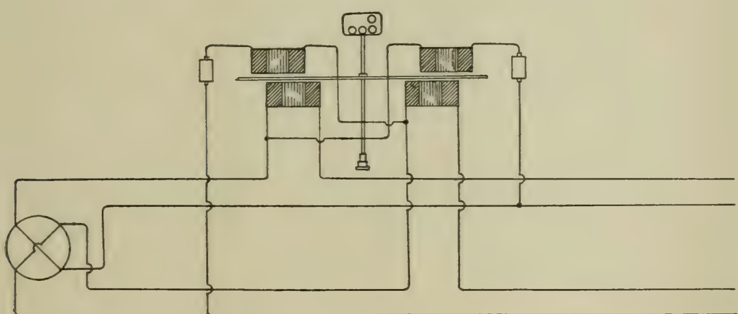


Fig. 1a.

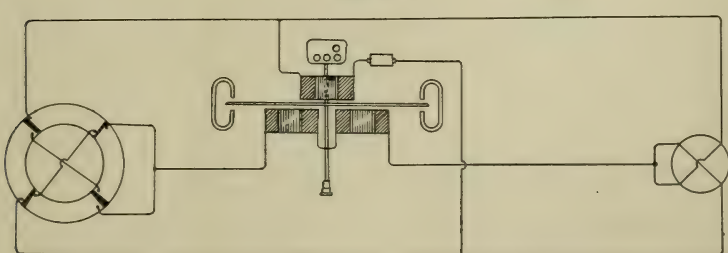


Fig. 2.

The next step was the designing of a novel choke coil covered by a patent taken out by Mr. Shallenberger, in which he described it thus:—

"It may be stated that by suitably proportioning the amount of iron, constituting an interrupted magnetic core, to the width of interruption or air-gap and to the winding employed, a lag of approximately ninety degrees in the current behind the impressed electromotive force may be obtained. Such an inductance coil properly proportioned will also compensate for changes of periodicity so that the inductive effect of the shunt current upon the armature will be proportional to the electromotive force independently of the periodicities over a wide range. Such a coil should be so designed that the cross section of the iron is sufficient to remain well below magnetic saturation, the interruption or air gap in the core being sufficient to require a magnetizing force which is large relatively to that required for magnetizing the iron alone, but the iron portion of the core should occupy a sufficient length of the magnetic circuit to secure a high coefficient of self induction with relatively very small loss due to the winding."

This choke coil is an essential feature of all induction type watt-hour meters to-day. A few manufacturers still employ a shunt coil with a separate choke coil precisely as Shallenberger did. The majority combine the choke coil and the shunt coil in one, but the fundamental principle is the same.

There then followed a string of other patents by Shallenberger, Conrad, Bradshaw and others, covering frequency adjustments, meter bearings, light load or friction compensators, etc.

The Moving Element.

The typical induction meter of to-day has for its armature a thin aluminum disc mounted on a short shaft. This, except for the register, is the only moving part of the meter. Consequently the lower bearing has to carry only about 1/5 or 1/6 of the weight of that carried by the jewel of a commutator type meter. This reduces jewel wear and friction to a minimum; consequently the accuracy and life of the meter are very much increased.

The Register.

A great deal of attention has been given to the design of the "register" or integrating train. The worm and gear (the crudest part of the train) usually forms the first reduction, i.e., the worm is placed on the top of the meter shaft. It has also been placed at the 3rd or 4th reduction, where it has less to drive and where it runs at a slower speed.

Standard clock gearing has been found wanting, so special shapes of teeth have been employed to still further reduce the friction.

The good practice of steel in brass has been generally followed for the counter shafts and bearings.

Lacquering and plating are both used to prevent the rusting and corroding of parts.

The number of change gears, to change the register from one capacity to another, has been reduced to a minimum to facilitate the changing of capacities and to minimize the chances for errors.

Bearings.

A very essential feature is the alignment of the bearings. Some meters are built on punched frames and the alignment of the bearings is usually only approximate. Self aligning upper bearings are also sometimes used. The upper bearing should be rugged yet sufficiently flexible to absorb the vibrations of the disc and shaft without noise. A perfectly rigid upper bearing would throw a greater amount of this vibration on to the lower bearing and cause greater wear on the jewels and pivot.

Most makers use a pivot lower bearing running in a cupped sapphire jewel. Another type is a steel ball running between two cupped sapphires, while in a modified form of this bearing one cupped jewel is used and the steel ball is set into a conical recess in the bottom of the shaft. This modification destroys the object of using a ball, since it prevents any possibility of the ball rolling on the jewels.

Permanent Magnets.

Permanent magnets are universally used for the ''drag'' or ''brake''; using the principle discovered by Foucault (1883). The disc is driven by eddy currents, and is retarded by eddy currents, so that changes in the resistance of the metal of the disc affect both sets of eddy currents alike and thus the accuracy of the meter is not affected by the disc changing in temperature. Many magnets are designed to fit into the remaining space in the meter case, and strength and permanency seem to be a secondary consideration. Their physical treatment is just as varied as their shape. The best magnets are ground to a standard length, bent at a definite temperature, are treated by vibration and by heat to relieve internal stresses and to reduce the temperature coefficient. After magnetizing to saturation they are reduced in strength to make them more permanent. This is done by boiling them in oil or subjecting them to a D.C. field or to violent mechanical shock or by rotating rapidly a copper disc between their poles and by other methods. The magnets are then given a final ageing for several months to weed out those that have been improperly treated, careful measurements of strength being taken before and after ageing to enable the defective magnets to be picked out.

Magnet Clamps and Adjustments.

The calibration of a meter can be no more permanent than the clamping of its magnets. If the magnets move out, say 2% of their distance from the centre of the disc, the calibration is changed by 4%. This is because, first, the magnets are now acting on a longer lever (2% longer), and, second, the portion of the disc between the magnet poles is travelling at a greater velocity (2% greater), from which it follows that the eddy currents are stronger and the damping effect greater.

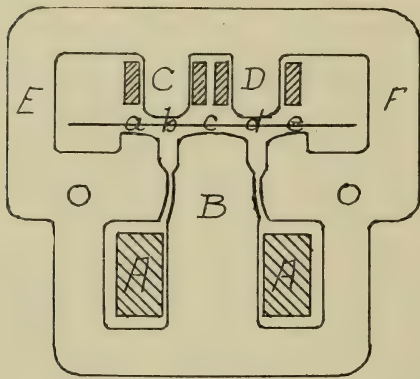


Fig. 3.

Michromometer adjustments are doubly good aside from their saving of time in adjusting the meter, for they conduce to more accurate results, first, because they are capable of finer adjustment, and, second, because they eliminate the tendency of the tester to say, "Oh, good enough will do," when the meter is just within the limits, in fear that the next move may throw the adjustment too far the other way.

The Electro Magnet.

The illustrations, Figs. 3 and 4, are the electro magnets of two well known makes of induction watt-hour meters. The principles employed are identical. Around the shunt coil "A" we have an interrupted magnetic path, the interruption or air gaps being on each side of the main shunt pole. Nearly all the flux generated by the shunt coil

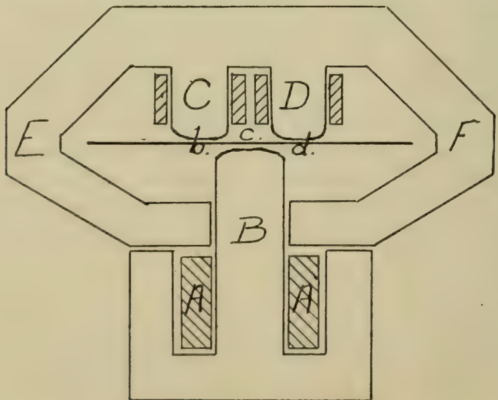


Fig. 4.

passes across these gaps and so does not cut the disc. So far this is identical with Shallenberger's inductance coil, and, as he explained, the current in the coil is very close to 90° behind the impressed E.M.F.

The useful shunt flux is the leakage flux, i.e., that portion of the flux which is crowded out of these gaps and passes up through the disc to the series poles ''C'' and ''D'' and back by way of the two lateral paths ''E'' and ''F''.

Around the main shunt pole ''B'' is placed a small coil closed on itself (or a copper ring fitted over the poles is sometimes used). This is the ''frequency'' or ''power factor'' adjustment, and the adjustment consists in shifting the position of the ring, or changing the resistance of the closed coil as the case may be. This closed coil acts as a ''shading coil'' and retards any flux that passes through it. The flux produced by the shunt coil ''A'' is nearly 90° behind the applied voltage, and the leakage or ''shunt flux'' which cuts the disc must pass through this closed coil and so is still further retarded or ''lagged'' and can be brought into exact quadrature with the voltage on the coil ''A''.

The series coils around the poles ''C'' and ''D'' produce a flux which passes from one pole to the other by way of the top of the shunt pole ''B'', and thus the series flux cuts the disc twice, once downward and once upward. This flux is in step with the current.

Sequence of Events.

The series flux being in step with the current and the shunt flux lagging 90° behind the voltage, we see that for loads of unity power factor, the shunt and series fluxes are exactly 90° apart. When the shunt flux is maximum, the series flux is zero, and when the series flux is maximum, the shunt flux is zero. With this understanding and as-

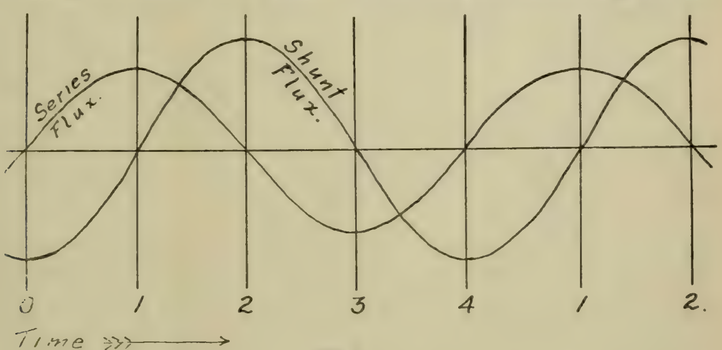


Fig. 5.

suming a flux passing up through the disc as a ''positive'' or ''plus'' flux and one passing down as a ''negative'' or ''minus'' flux, we may lay out the sequence of events in a table, Fig. 6, showing the direction of the fluxes for each quarter cycle. Fig. 5 shows the shunt and series fluxes plotted on a time base with the quarter cycles marked 0, 1, 2, 3 and 4. On figures 3 and 4 the small letters, a, b, c, d and e, show where the fluxes cut the disc, a, c and e being shunt flux and b and d being series flux. The plotting of Fig. 6 is obvious. You will notice

that as we follow down the quarter cycles a plus flux travels from d to c to b to a. This is followed half a cycle later by a minus flux, which is in turn followed at the next half cycle by a plus flux, and so the flux travels across the disc and tends to carry the disc with it. This is analogous to the rotating field of an induction motor cutting the squirrel cage secondary or rotor and causing it to rotate.

In an induction **motor**, the full load "slip" is 2 or 3 or 5%. In an induction **meter**, the full load slip is about 95 to 97%.

There is another way of showing why the disc goes round. We may consider that the series flux makes an eddy current in the disc, and that this eddy current is strongest as the series flux is passing through zero, because the strength of the eddy current depends on the rate of change of flux, and this rate of change of flux is greatest as

Polarity of fluxes.

	"a."	"b."	"c."	"d."	"e."
Time,- 0.	o	−	o	+	o
1.	−	o	+	o	−
2.	o	+	o	−	o
3.	+	o	−	o	+
4.	o	−	o	+	o
1.	−	o	+	o	−
2.	o	+	o	−	o

Fig. 6.

the flux passes through zero. Now, as the series flux is passing through zero, its eddy current is strongest, the shunt flux (lagging 90°) is greatest, so the series eddy current acted on by the shunt flux is pulled to one side, and drawn around the shunt flux. As the shunt flux goes to zero, the opposite series flux acts on the eddy and draws it over opposite the series pole. Now it takes work to move a current in a conductor, and this work appears partly as heat and partly as mechanical energy in the rotation of the disc.

Friction Compensation or Light Load Adjustment.

The fluxes in the iron at each side of the coil "A" will be in phase with each other and so could not alone produce a torque in the disc, but if we place a metal loop or closed coil in the air gap at one side of the shunt pole, the flux passing through the loop will be "lagged" a

little and so it will cut the disc a little later than the flux on the other side. This gives a shifting field which, as we saw above, produces a torque in the disc. By adjusting the position of this loop to enclose more or less flux, we get a greater or less torque on the disc. This is the "light load" or "friction" adjustment.

It is preferable to have these friction compensators so located that their adjustment has little or no effect on the frequency adjustment, otherwise the tester must "see-saw" from one adjustment to the other until both are perfect.

Mounting in Case.

The mounting and the case are worth careful consideration. In some meters the series and shunt elements are separate, one being mounted in the cover and the other in the base. This method is not exact enough in the relative location of the shunt and series iron, a very slight error in their relative positions materially affecting the calibration.

The best practice is to mount the complete magnetic circuit on a rigid metal casting which also carries all the working parts of the meter. This casting is usually provided with three lugs which register with three bosses or studs in the base. With this construction, the meter may be removed from its base for inspection and then replaced without altering its calibration.

Heavy cast iron covers are often used and are, indeed, necessary for some types of meters to shield them from external fields. But in these meters the calibration is affected by the removal of the cover, sometimes 8 or 10%. This shows an abnormal amount of stray field wandering promiscuously in the meter.

Testing.

It is a common practice to arrange the shunt circuits so that they can be separated from the series coil in the terminal box. This is done to cut down the time required for factory testing. Eight or ten meters are connected in series in a row with a standard, also in series, and the row is gone over from end to end once for each adjustment and inspection.

In cases where this separation of the shunt circuit is not provided each tester has a standard and connects but one meter at a time, making all adjustments and inspection on it. Then he passes it on for registration run where the gears are checked, while he turns his attention to another meter.

Again, there are two methods of setting the P.F. or frequency adjustment. The most generally used method is to employ a choke coil so adjusted as to give about 50% P.F. The other method is to adjust on zero P.F., or exact "quadrature", this "quadrature" being obtained by using a 2-phase circuit and a small induction regulator connected as a phase shifter. With this arrangement exact quadrature can be obtained and the meter set so that its disc stands still. This latter is the

better method, since a comparatively small error at 50% P.F. becomes a large error at zero P.F.

Polyphase Meters.

We are all familiar with the method used on test floors for measuring power in a 3-phase line, using two watt-meters and adding or substracting their readings as the P.F. is above or below .5. A polyphase watt-hour meter is in effect two single phase meters with their discs mounted on a common shaft. The shaft does the adding or substracting

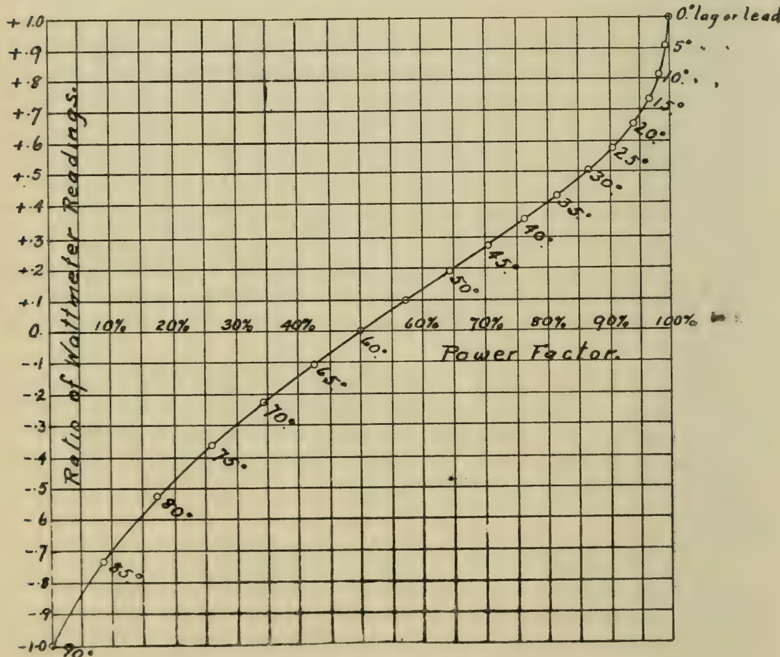


Fig. 7—Power Factor Chart.

faithfully and without error. Such a meter is used on two-phase or on three-phase lines without changing the calibration. This is identical with the use of two single phase meters to measure either 2-phase or 3-phase power without changing their calibration. This may be explained as follows:—Polyphase meters are calibrated as single phase meters by connecting their series coils in series and their shunt coils in parallel making $2 \times E \times I$ give full load speed of the disc, where E and I are the full load volts and amperes. Now when used on a 2-phase line each half acts as a single phase meter. The power in a 2-phase line is $2 \times E \times I \times \text{Cos } \phi$, $\text{Cos } \phi$ being the power factor; so obviously the meter will read correctly. When used on a 3-phase line the power is $\sqrt{3} \times E \times I \times \text{Cos } \phi$, which may be written 2 (Cos 30°)

$\times E \times I \times \text{Cos}\ \phi$, i.e., 2 (Cos 30°) = $\sqrt{3}$. Each half of the meter as connected to a 3-phase line with load of unity P.F. has 30° between its voltage and its current, and so each half reads Cos 30° $\times$ E $\times$ I, and the whole meter reads 2 (Cos 30°)EI, which is the power in a 3-phase line at unity P.F.

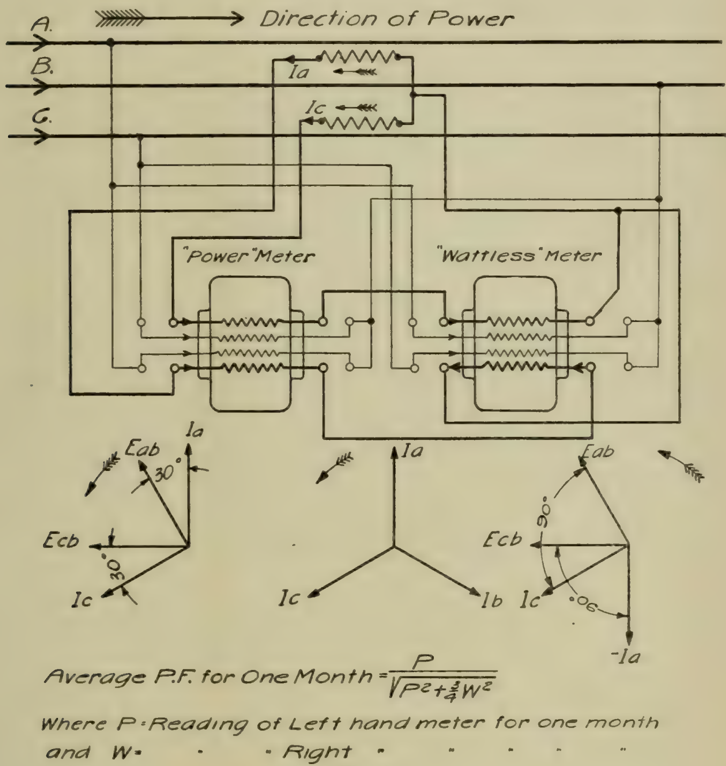


Fig. 8.

By special series coils or by the use of series and shunt transformers a polyphase meter can be connected so as to read the total power in a 2-phase circuit, a 3-phase circuit, a 3-phase 4-wire circuit, or any of the 6-phase circuits, regardless of whether the load or voltage are balanced or unbalanced.

Average Power Factor of 3-Phase Circuits.

When measuring the power in a 3-phase circuit on a test floor it is usual to use two single phase watt-meters and add their readings to obtain the total power. The power factor may also be obtained from

these two readings by using the following formula, assuming that the load is balanced:—

$$\text{Tan } \phi = \sqrt{3} \times \frac{W_1 - W_2}{W_1 + W_2}$$

It is then necessary to change the tangent into the corresponding cosine, which, of course, is the power factor.

In Fig. 7 a curve is shown for obtaining the power factor directly from the ratio of the watt-meter readings $\frac{W}{W_1}$. If watt-hour meters are used an average P.F. is obtained. Fig. 8 shows two polyphase watt-hour meters so connected as to read the power and the average power factor. This arrangement has the following advantages: 1st, the power is recorded entirely on one meter, obviating the necessity for adding or subtracting. 2nd, on unity P.F. the so-called ''Wattless'' meter stands still, and thereby gives an indication of the proper field adjustment for synchronous motors or rotary converters.

President Dion: Gentlemen, you have heard an able paper by Mr. Baker on a subject that is so closely connected with our operations that it deserves a great deal of attention. No matter how perfect our methods may be, if our means of measurement are defective, we are going to suffer, or our customers are. I would like to see this paper thoroughly discussed, and I will ask Mr. H. S. Brown to open the discussion.

Mr. H. S. Brown: I think our Papers Committee are certainly to be congratulated on procuring such an excellent paper as Mr. Baker has given us.

There are a few points which I noted in reading over this paper originally which seemed to indicate that there is some difference of opinion among meter designing engineers in regard to some of the mechanical features of the meter. One point is under the head of ''Registers.'' Mr. Baker mentions that some designers place the worm gear reduction at the shaft of the meter while others place it at the third or fourth position in the reduction. It is generally conceded that a worm gear is not as efficient a means of transmission of power as is a spur gear, other conditions being equal. This, however, in the meter register is not the case. The only work done by the gear is that of turning over the various elements of the register and this work is proportional to the speed. Now, if you place the worm reduction at the third or fourth position you necessarily increase the speed of the first few elements of the register, and, consequently, you increase the friction in proportion to the increase in the speed. This, I think, offsets any advantage which is gained by placing the worm gear at the third or fourth position. Another point which Mr. Baker brings out is the use of steel spindles in registers. Of course, it is very true that steel to brass makes a somewhat better bearing than brass to brass, but in a meter register

there are some other factors which some engineers consider more important than low friction. They claim that constant friction is of very much more importance than initial low friction. Now, when a steel shaft is used it is always liable to corrosion. It is true some engineers recommend lacquering and dipping, but, unfortunately, the latter cannot be successfully applied to the bearings in a register, while the dipping or plating of necessity must be so thin that at the gear teeth it is liable to wear off or scale off and be a source of considerable annoyance later on.

Another point which is very much discussed in connection with meters is the question of bearings. Some engineers have adopted a ball which in the true sense is not a ball bearing. It is true that a ball, while not in the true sense of the word a ball bearing, offers under varying conditions of load, various surfaces to the jewel. This is supposed to be of considerable advantage over the ordinary pivot bearing. This also is considered by some of the engineers of only theoretical advantage for the reason that it is impossible to produce a ball which is a perfect sphere, and it is also impossible to produce a ball having a uniformly hard and polished surface. Very exhaustive tests have been carried out to prove this point. These tests have been made by taking an equal number of samples of each type of bearing, placing them in meters arranged under various conditions, such as various weights of rotating elements and so forth, and measurements taken at various periods. These bearings have been run up to ten million revolutions, which is about equal to seven years' operations of the average house meter. In compiling the data thus obtained and plotting the curves one against the other, it has been proven quite fairly, I think, that the ball bearing is the exact equivalent of the pivot bearing as regards friction. On the other hand, the ball as it is used in some types of meters, with a double jewel, is more expensive initially and costs more to maintain than does the pivot bearing. This, some engineers consider, a disadvantage, as all our central station friends are pressing for cheaper meters initially and meters which are cheaper to maintain. These are all the points I have to discuss, and I thank you, Mr. President and gentlemen, for the privilege of doing so.

Mr. Lambe: Mr. Chairman, I think it is presumptuous to discuss the subject after Mr. Baker has covered it so thoroughly. We are certainly to be congratulated on such a paper from such a gentleman. He comes from a meter family, as you all know, and I think he is to be congratulated on having an audience that is really interested, because it is composed practically of operating men, and those are the men that the papers should reach and interest. Mr. Baker has covered the subject so thoroughly that after discussing one or two points I shall speak for the most part on my impressions regarding the Watthour meter in the future. I should like Mr. Baker to discuss it now when he is fresh, and not wait till the end of the discussion. On page 4 reference is made to commutator meters being used on A. C. or D. C. without calibration, or

practically so. Personally, I object to that idea being put into the minds of people, for the reason that some commutator meters show tremendous errors when calibrated on A. C. and used on D. C. That is the older types, the old Thompson, for instance, an error of from 5 per cent. as a minimum up to in some cases 25 per cent. as a maximum. I think even the best modern meters of all the meter makers that are standard to-day have an error of from two to five per cent. Now, that is too much to allow on top of the original error that may be there. For instance, if you calibrate that meter on A. C. and set it at as much as one per cent. fast and then put it onto D. C. and it starts off two or three per cent. faster, that is too large an error to impose upon the public, and you don't want it said that your meters have that characteristic. Nobody does. So from my point of view in the Inland Revenue Department, we are trying to discourage, more or less, any combination meter of that sort, and we are asking that a meter shall be calibrated and used on the market for the exact circuit on which it is to be operated. What would you say to that, Mr. Baker?

Mr. Baker: I think that is perfectly right. With one or two meters that I have had occasion to check I found the error was a little less than you mention.

Mr. Lambe: What is the minimum?

Mr. Baker: On 25 cycles the error is very small. In 60 cycles the error in some meters I tested would be 2 per cent., I should say, not more, but on higher frequency it is entirely out of the question, and, as you mention, it is a dangerous practice to follow. I merely mentioned it as a theoretical point. It is very apt to lead to serious errors.

Mr. Lambe: On page 7, speaking of the weight of the moving element, you refer these to a single phase, I suppose? It strikes me that the tendency is for the weight of the moving element to go up somewhat, is it not, in the latest designs, though there was a downward movement not very long ago towards a light element?

Mr. Baker: No, I should not think so.

Mr. Lambe: Some figures led me to believe that the makers were going to the heavier rotor. Again on page 13, with reference to polyphase meters, personally I am strongly opposed to a type of meter that is coming to us from Europe. I refer to the polyphase meter for balanced circuits. Of course it is a good thing in one way, in that it is an effort to produce a cheaper meter to do a certain special class of work, but my own view is that it is impossible to have a really balanced polyphase circuit. You say a motor is a balanced load; well, if you try out the best of modern motors you may find quite an extraordinary unbalancing, and when you add to that the necessary unbalancing there must be in voltages, and sometimes in phases, you will get quite large discrepancies. To my mind, a balanced polyphase meter is not a very good thing for us to introduce into this country. Furthermore, even if the load were balanced in the beginning, you have no guarantee whatever that it is going to stay

that way, because as the plant grows a few lights will be added here or a single phase motor there, and thus throw out the original balance.

Then it would be interesting if Mr. Baker would tell us something about the reason for a change in design, that seems to be pretty universal just now, namely, the superseding of the polyphase meter with the two motor parts on the one disc, by the vertical type with two separate discs set one above the other and a motive and a retarding element on each. I suppose the question of interference between phases is largely responsible.

Mr. Baker: The interference is the main thing; but there are also mechanical reasons.

Mr. Lambe: Then I think we like the appearance of the longer type; so almost every maker is bringing out that design. An interesting point in connection with testing polyphase meters, which I mention because it has come up several times quite lately, is that a great many people have been testing polyphase meters by simply connecting, as Mr. Baker says, two current elements in series, and two potential coils in parallel, and letting it go at that. Now, that is going to introduce, or may introduce, a very serious error, because if one of the elements were five per cent. fast and the other five per cent. slow, they would balance out under that test and the meter would read correctly; but put that meter into polyphase work and assume that you were working on 50 per cent. power factor (which none of your gentlemen, of course, are, though you might some day), and one element would tend to stand still. Now, suppose that was the element that was originally five per cent. fast, you have then a meter running five per cent. slow, which would be almost worse than the 50 per cent. power factor. The moral is, test each element separately.

Another tendency in design that I thing is becoming established, is the elimination of the glass case. I remember when we were all most enthusiastic about glass cases, but I think they are not as much needed now as they used to be, and that for service use, they will grow less and less popular. As far as our particular work is concerned in connection with meters, with an eye on the future, we are trying to do a few things towards bettering Canadian meter practice. In the first place, while we are not demanding it, nor putting it into any rules or regulations, we are saying that one location for the terminal box, either always on top or always on the bottom, would be better than the variety of designs now on the market. This would not only standardize the wiring to the meter, but would also tend to reduce the cost of the instrument itself, because of the smaller number of types to be produced by any given maker. Then another feature we are trying to standardize gradually is the wiring to the meter, which we suggest should always come in at one side, say the left, and go out to the load from the right hand terminals. If all makers were following the same arrangement it is obvious that the wiring in the vicinity of meters, which now is often very unsightly, could always be kept near

and entirely safe, besides which the cost of installing or changing meters would be much reduced, and the chances of mistakes in connections materially lessened. Another point is a standard direction of rotation for the disc, which is very desirable, because everybody, your own men or the public, can then instantly tell whether a meter is running backwards or forwards. Another point that to my mind can advantageously be standardized is the connecting of the potential of three wire meters across the outlets, instead of between an outer and the neutral. It would be interesting if Mr. Baker would tell us which he considers the best practice, from the standpoint of accuracy, because if you do not have absolutely equal voltage on the two sides, there is an error, no matter which way you design and connect the potential coil. To get absolute accuracy you must have two coils, one across each voltage. As far as nearly all other features are concerned, connecting across the outer is preferable, because you then have less wiring and fewer chances for mistakes, and there is less temptation to interfere with the meter, because if there is no potential tap one cannot stop the registration of the instrument so easily. Another most important feature, and one that is called for by the regulations, is the marking on the meter, somewhere on the dial or name plate where all can see it, the value of one disc revolution in the universal standard of Watthours per revolution, thus simplifying the testing of meters in every way. Formerly the value used to be marked in watt minutes, sometimes in watt seconds, and some makers said so many revolutions on full load. Well, the question then was, what was the full load, because the same maker one week called full load say a thousand watts, and the next week the same man said it was eleven hundred watts, ten per cent. difference between two meters apparently identical. Next is the matter of universal marking of dials. This is a difficult matter, but I think you will agree in saying that it would be very nice for you and for your customers to have but one type or arrangement of dial, free from everything but the simple value of the dial, plainly marked, so that anyone could go and read any meter at any time.

Mr. Webber: Mr. Chairman and Gentlemen,—Speaking from the standpoint of a central station man, we cannot overestimate the benefit of a paper of this kind, because thereby the central station man gets into close touch with the manufacturer. I was also very pleased to hear from Mr. Lambe, whom we all recognize as doing the very best he can to improve meter practice in central stations. In looking over Mr. Baker's paper I noted one or two points for discussion. The earlier types described by Mr. Baker lead up, more or less, to the latest type of induction meter. To-day we get a meter that a few years ago was thought almost impossible. There is one point that Mr. Baker makes in mentioning the D. C. meters, namely, that it is not good policy to use a D.C. meter on an A. C. current. From the central station viewpoint there is one very good reason for not doing so. It costs very much more to maintain D. C. meters, and if you have them on A. C. currents my advice would be to get rid of them as quickly

as you can. On page 4, "The wound armature, the armature supports, the necessarily long shafts, the drag disc and the commutator make the moving element large and heavy." That fact alone makes the D. C. meter a most expensive meter to maintain. As to the ampere hour meters, I think Mr. Lambe will agree with me in saying that we have been trying to eliminate them for some time. I thought they were now pretty well all eliminated. According to our Electricity Act, they are not legal in this country. In regard to bearings, there has always been a great controversy among the manufacturers as to the best style of bearings—I saw an account of some tests made recently with meters having ball bearings, with sapphire jewels underneath and above the ball bearings. They tested them three ways. Before the test some had a little oil put on both bearings, some were dry, and others were immersed in oil. After running these meters for some time they found the meter that gave the best results was the one where the bearings had been saturated in oil. The simpler the bearing is on an induction meter then the lighter the moving element the better. You might get a little finer work from the meter, but I do not think it is at all necessary, and it simply leaves something to get out of order.

On page 8, "Maget clamps and adjustments. The calibration of a meter can be no more permanent than the clamping of its magnets." Now, when a meter is found defective it is brought in to be re-calibrated, and it is a great temptation for the man in the test room to move these magnets right at once, especially on D. C. meters. It is one of the last things he should do, because if he once gets them out of place, it may be a long time before they are made right, and because the slightest alteration in the location of the magnet will alter the speed of the meter a great deal. Mr. Lambe spoke of the polyphase meter for balanced loads. To my mind, the central station man should consider when he is buying meters the possibility of that meter being used anywhere on the circuit. If he is going to buy a meter that he can use only for balanced loads, the chances are the contracting department will sign up a contract where the load is not balanced, and that renders his meter useless. I think it is a very necessary thing, as Mr. Lambe has mentioned, that meters should be bought to be used as generally as possible in the station for whatever business comes up. It is very nice to buy a special meter if you have a big customer, but the most economical way is to buy a meter, if possible, that you can put anywhere. I was glad to hear Mr. Lambe's discussion on the glass covered meters. We have tried a great many glass covered meters, and I do not think there is any great benefit derived, except that it pleases the consumer and makes a better appearance. We have consumers who insist on glass covered meters. The trouble is that if you put a glass covered meter in for one consumer, another sees it and wants the same thing. Of course, we try to satisfy them as well as we can. The more we can make meters for universal use in our plants the better we can serve our customers, and the cheaper we can do it. Mr. Lambe pointed out very well the advantage of the manufacturers getting

together and making the connections, the rotations of discs, and dials standard. That is another thing that helps the central station man a great deal. If he has a variety of meters on the circuit perhaps he has to go out and instruct the man how to test the meter, and sometimes he will find that the meter reader will make mistakes in reading. In central station that have been running a number of years there is always a variety of meters on circuits, but my advice in that respect is to go slow and let the manufacturers, if they can, get together and standardize the outstanding features as much as possible.

The President: I think it is a good thing for the manufacturers and the central station managers and the government to get together and exchange views. I think the department with which Mr. Lambe is conected is earnestly trying, without injustice to the manufacturers, to obtain standardization on some features. From a practical standpoint I think the standardization of dials is a most important one. As regards the glass covers, the company with which I am connected was one of the first to use them, and they used a great many. The reason was that they pleased the customers. They were attractive and they removed the mystery which one attaches to a meter. They could see it working, and the impression was that if the thing was so honest that you could afford to leave it in the open without any concealment then no one need worry about it. However, this phase of the business will pass. We will come to a time when everybody will believe that the meters are correct—in the milleneum—(laughter)—or else they will believe they are so bad there is no use worrying any more about it, as they do about the gas meters. I am not knocking the gas meter, but the general public for fifty years has been sending the gas meter to a hot place, and there seems to be no chance to redeem it; but we may be more fortunate with the electric meter.

Mr. McDunnough: We operate our lighting circuits usually on 60 cycles, but in times of low water we are obliged to shift some of the light circuits onto 30 cycles. I would like to know if Mr. Baker can give me any idea of the probable error of a 60 cycle meter on 30 cycles.

Mr. Baker: A 60 cycle meter is not fit to operate on 30 cycles for any length of time. If you do you are taking considerable risk, because the shunt coil of that meter is wound for 60 cycles. A hundred volt meter wound for 30 cycles would have very nearly, if not exactly, twice the number of turns in the shunt coil. That is, in using a 60 cycle meter on 25 cycles, you are working your iron at double density, and you will have such a current flowing through your shunt coil that you will very soon burn it out. It may last a month or a year, but you are running that risk. The error is somewhere about ten or twelve per cent.

Mr. McDunnough: That would be ten per cent. slow.

Mr. Baker: I could not say just which way it is.

Mr. Webber: We operated some 25 cycle meters on 60 cycle current for a short time when we were making a change, and we found that they ran upwards of ten per cent. slow, depending on the load carried.

Mr. Hornby: Mr. President and Gentlemen,—I must apologize for coming here and talking to you on this subject, but the object I have in coming from London, England, is to see the factories here, and that is very, very interesting to me. I, personally, am very much obliged to Mr. Baker for a great deal of useful information given in this paper. A very curious thing about meters is that the more you get together and the more experience you can exchange the more points seem to arise. You seem to think you know everything about it yourself and then you find there are a good many points you did not think of. Referring to the historical part of the paper, Mr. Baker mentions the little Faraday machine, and it may be of interest to you to know, since he did not mention it, that this machine is still in existence. It is at the Central Technical College, in London, and still works. If you are in London any time you can go there and see also the first motor meter. With regard to the early work on meters I do not think the work of George Hookum should be overlooked. He operated about two years before Ferranti, and had actual meters working, of which I have seen a price list. I may say that I worked with the firm of Hookum at one time, and Mr. Hookum deserves the credit of the ampere hour meter, although the work of Ferranti is equally important. Mr. Hookum gave us the first definite knowledge of magnets for meter work. Referring to Mr. Lambe's remarks on balanced load polyphase meters, I am very much in sympathy with the ideal of either making the balanced load three-phase meter an inadmissable meter or in some way or other making it a quite distinctive meter. In Europe, on account of the severe competition there, the firm I am with had to make this meter, but it is not a good meter. It is used on unbalanced loads and even on so-called balanced loads. No doubt Mr. Baker will bear me out in saying that in actual practice the balanced load does not exist if you are seeking accuracy as regards measurement, and I would suggest to Mr. Lambe as representing the Department of Inland Revenue, that if a regulation could be brought out to put some distinctive label on these meters, something in the nature of a caution label, I do not think any manufacturer of them would object, because we find, particularly in export work where one is quoting to firms thousands of miles away, that firms quote balanced and unbalanced under the same general name of three-phase meters, with the result that an engineer thinks he is buying the proper meter and, when he gets it, finds he has not, and trouble follows. I think the idea of a special caution label, if it could be universally done, would be an improvement, and would be a public warning that this meter was only active under certain conditions.

With regard to this power factor arrangement, I may say it is the first time I have seen in print this formula which is a familiar one to me, and I suppose to most of the meter men. It is a pity it is not more widely known. I have shown it to many engineers and in nearly every case it has been new to them. I would only add that this diagram that Mr. Baker shows is just an instance of what I said before. The idea of using a polyphase meter for this purpose is quite new to me. Mr. Baker,

in the last paragraph, do you mean watt meters or watthour meters in this minus formula?

Mr. Baker: Either. Watthour meters will give you the average power factor.

Mr. Hornby: Is there not an error there? With the watthour meter should that not be the sum over the difference, or the difference over the sum?

Mr. Baker: It would be the same for either.

Mr. Hornby: I was under the impression that there was a difference. Anyway it is a very useful formula, and you will find it worked out in the various books on mathematical treatment, but very rarely is an application stated.

Again, with three-phase meters, this question of interfering is just arousing our attention in Europe. I see you have hit it all right, and I am very pleased to see it, because in the first place the question of testing three-phase meters on single phase is very important, and, in the second place, unless the elements do not interfere with one another, the method of single-phase testing is not accurate. If the elements are free from interference, that is to say, if one element does not affect the other element, then the method of single-phase adjustment is not very accurate nor desirable, but I think that, generally speaking, a more convenient, and, in the end, a more accurate way, is to test each element as a single-phase element, and if you have the three-phase circuit there you can test the meter out and you can see if there is any interference.

Mr. Lambe spoke of the long meters and the squat meters. You can almost tell a meter that is free from interference by the shape. Now, putting the element one on top of the other gives it that characteristic oblong shape, while you can see if you put the elements side by side on one disc you get a squat arrangement, and, generally speaking, one that is not free from interference. The question of interference is one that affects you gentlemen as station men. When you get these meters that interfere on circuits you get all sorts of errors, and you cannot always explain them when you have got a result which does not seem to tally with what you think it ought to be, but you can nearly always put it down to interference. In most specifications in Europe, at least, we now get a clause saying that the elements must not interfere with one another, and this is bringing about a radical change in the design, which goes a long way, I think, towards explaining Mr. Lambe's remarks that the makers were adopting this double element method: that is to say, two separate discs. One prominent maker in Europe has given up the making of the single disc, and that, as we all know, means a big cost to them in scrapping their own tools.

There is one other point I would like to mention, and that is the question of maximum demand meters. Mr. Baker has not dealt with this, but I came to America just to investigate the market for meters, so I suppose Mr. Baker and I will get better acquainted in competition as time goes on. I have one class of meter for which there seems to be

a demand in this country, and that is a meter which the load factor by showing the average maximum load demanded as well as the kilowatt hour. We have had to deal with this problem in Europe in connection with the great hydro-electric developments in Switzerland and Norway, where the system you have here of selling on the horse power per year basis is general. This has called forth a demand for a meter which will accurately measure in the same way as a graphic recording instrument. I have here a sample of the mechanism which has been worked out. I cannot show it to you all very well here, but if any gentleman wishes to see it later on he may do so. You simply have the ordinary kilowatt hour dials as in the ordinary meter, and, in addition, there is a circular disc. Over this is the pointer which indicates the highest demand in watts, being worked from the same mechanism as the kilowatt meter.

(Mr. Hornby at this point shows the type of meter he is referring to, and explains its working).

There is one advantage about this system. Instead of charging so much for kilowatt demand and so much for kilowatt hour you can charge on a pure load factor basis. That is to say, you can start with a rate of something like twelve cents per kilowatt hour for a certain number of hours' of use and then give a percentage reduction according to the increased number of hours used. If you have two consumers who take a certain number of kilowatt hours, but one does so in one thousand hours, and another in five hundred hours, you know which is the better man for you, and, starting on a high rate you can give him a discount according to his load factor. That is, perhaps, a more simple system and more easily understood than so much per kilowatt demand and so much per kilowatt hour.

Mr. Kemble: I would like to ask Mr. Baker a question in mathematics. On pages 14 and 15, where the readings are given I think there is an error. I think W1 minus W2 should be W1 plus W2?

Mr. Baker: Yes.

Mr. Pratt: I have listened with a great deal of interest to Mr. Baker's paper and also to the discussion that has taken place. I consider it a privilege to hear such an authority as Mr. Baker, and also such an authority as Mr. Hornby, on this subject. Coming back to the early part of Mr. Baker's paper and the discussion by Mr. Brown, I may say we have had some experience with meters employing in their registers both brass and steel, the steel being in the pinions. Under some conditions a steel shaft is a disadvantage. Where there is much dampness the steel will corrode and stop registration. Whether that is sufficient to offset the increase in efficiency of the register I am not prepared to say. In regard to the lacquering of registers we find it is a considerable advantage. The meters which were lacquered and which had been up for some years we found in first-class condition on opening up, while some that were not were badly corroded.

As to glass covers, we have used both styles. We found that with the thick glass which must necessarily be used in the covers there is a

certain amount of distortion, and unless the meter reader gets right up in front of the meter he is sometimes apt to make a mistake.

As to the measurement of power factor, it is something which is becoming increasingly important in this age of cheap power distribution. Although our company is probably the third or fourth company in Canada in point of power distribution, I may say we had not heard of the method outlined by Mr. Baker until a few months ago when it was brought to our attention by my good friend, Mr. Foote. The old method of using a kilowatt hour meter and ampere hour meters to determine the power factor is very uncertain. I may say that in one of the largest manufacturing establishments in Hamilton we used the ampere hour meter and the results we got were quite paradoxical, the kilowatt-ampere hours were less than the kilowatt hours shown by the watt meter.

I would like to ask Mr. Hornby a question. What in his opinion are the relative merits of the cyclometer and the clock dial registering systems?

Mr. Hornby: When I first came to Great Britain with continental meters, that is, meters made on the continent of Europe, I found in England generally the preference was for the time pointed dial, the reason being that the early Scallenberger motors, which had great sale in England, had been fitted with that class of meter. Certain trouble had arisen, and people said they preferred the old kind to the cyclometer. I am pleased to say, however, that the cyclometer dial now in England is almost universally preferred, and the old English makers have lately changed over from the pointed dial and are prepared to furnish the cyclometer dial, and the other as an alternative. This was to meet the demand, but when I say that two of our largest English makers have changed, it is quite certain that the sentiment has changed. I think with our present manufacturing methods, no matter who the maker is, that cyclometer dials can be, and are turned out, which are just as reliable as the pointed dial. Probably Mr. Baker will bear me out in this, that the cyclometer dial takes considerably more power to drive than the pointed dial. A meter with a very low torque I would fit with a pointed dial. With the high torque meters that are now in use, with the well made cyclometer dials, you need not fear anything unless it is below ten. The friction of the cyclometer is variable and the record of the meter may vary too. If you test the motor you may find it varies two or three per cent.

Mr. Lambe: Would Mr. Baker say something to us about the question that was raised the day before yesterday about a cheaper meter. The use of motors without shunt coils is fairly universal on the Continent, and I believe they are coming in to the United States to quite an extent, though the point does not affect Canadian practice very much, because, in the first place they are the direct current type only, of which comparatively few are used over here, and, secondly, our regulations prohibit the use of an instrument without shunt coils, unless it be called an ampere-hour meter, which is what it really is.

Mr. Baker (closing discussion): Regarding the point as to placing the worm on the first shaft instead of on the third or fourth shaft, the same objection applies here as to cyclometer dials. If you can reduce the friction in the movement that the meter has to drive to a very small fraction of the power which is at your disposal then considerable variation in that friction will make very small variations in the registration of the meter. The main objection to the cyclometer dial is that it takes so much power that a small variation in its friction seriously affects the calibration of the meter.

Further, with regard to ball bearings, I agree that you cannot make a ball a perfect sphere, but as the old saying is, ''There is no force however great can stretch a thread however fine into a horizontal line, which is absolutely straight.'' But you can very closely approach it. The ball is so small that you can get the surface with practically a constant density, hardness and uniform polish.

I wish to take exception to a view that has been expressed in different quarters, that the ball does not rotate. By careful examination you will see that the ball does rotate, and, therefore, it is much better than the pivot bearing. A pivot bearing can be made to operate with initially less friction than a ball-bearing of the type to which I refer, but the friction in the latter is more constant. We make life tests of meters running into several million revolutions, but unless the meter is run under service conditions such a test is liable to be anything but indicative of correct results. When running the disc very fast a pivot will tend to grind in, and a ball will tend to jump, thus giving the meter a service which it is not intended to receive. With regard to the expense of maintaining the ball bearing, the experience I have met with shows this to be practically nil.

I should like to emphasize the point that Mr. Lambe brought out, referred to by Mr. Hornby, i.e., balanced meters for three-phase work. I had two weeks of hard labor over in Michigan going over a large system there and recalibrating the meters all over the system because a well-known engineer had begun the practice there of using balanced meters as a standard assuming the load to be balanced. The system had nothing but induction motors and rotary converters, and a very small percentage of lighting load. We went into a large furniture factory to examine the induction motors to see where the unbalancing was coming from. They had a one hundred horse power motor, two fifty horse power, and four twenty-five horse power, and a number of smaller ones, and we had to argue for a quarter of an hour before we could get permission to look at the fuses. The electrician in charge laughed at us when we suggested that there was something wrong there, especially when the hundred horse power motor was found all right. But when we showed him on the fifty horse power motor that he was running on a single phase and throwing the system out of balance, the laugh was the other way. This engineer from New York said he would never use a balanced meter again in his life. Mr. Lambe's remark with regard to uniformity

of practice, the rotation of the disc, and the dial, are points well made, and it is desirable to work towards that end. As to the question of maximum demand meters, there is extra work for the meter to do, and it means extra friction in the movement and less reliability, particularly on light loads and, of course, extra expense.

Mr. Lambe: Taking the ordinary meter, about what percentage is found?

Mr. Baker: I cannot tell you, but it is very small. In an ordinary meter I would say a small fraction of one per cent.—one per cent. at full load, not one per cent. at five per cent. of full load of the meter. When power house men are asking for meters to read accurately away down on small loads, if the friction is, say, one per cent. of full load torque when you get down to two or three per cent. of full load this friction would use up twenty-five or thirty per cent. of the torque of the meter at this light load. There are a couple of maximum demand meters or attachments made. One is a movement which is operated by a small induction motor which runs continually. The meter operates an escapement somewhat similar to the escapement that is used in a clock or watch, like the old barrel type escapement. The motor supplies the power, while the meter merely governs the number of times per second that it allows the wheel to shift. This is theoretically very fine, but rather expensive. There is another meter being worked on which has three tumblers which are continuously operated by the meter movement. The second tumbler starts twenty seconds after the first, and the third, twenty seconds later still. Each one operates for a minute, and the moment the third starts the first drops back again. Then a printer comes down and prints this maximum on a disc or slip so that you can get a true maximum of any minute, which gives you a far more accurate maximum than one pointer coming up for five minutes and then dropping back to zero. With regard to the ampere hour meters which Mr. Lambe mentioned, one of the great difficulties is that one station operates at one hundred and ten volts and another at one hundred and fifteen volts, and again on different parts of the same system different voltages are found. You have all kinds of constants and variables to look after. The multiplication of difficulties, I think, is obvious, and there has been practically nothing done in this country along that line.

The President: I agree fully with Mr. Baker as regards the ampere hour meter. I do hope it will not be introduced, and that the Government will not favor its introduction. I think it will open the door to endless troubles.

I wish to thank Mr. Baker on behalf of the Association for having presented this paper here. It has brought out a most interesting discussion, and I am sure we have all derived instruction and benefit from it. I am sorry that the time at our disposal will not permit of more lengthy discussion on these papers.

Mr. G. M. Gest was not able to get here, but Mr. H. H. Stannard has kindly come to give us a talk on ''Underground Construction'' in

the place of Mr. Gest, and we will now ask Mr. Stannard to show us the moving pictures which I understand he has with him.

Mr. Stannard: I am sorry that Mr. Gest is not here to do this, but illness at home made it impossible. If we could have had the theatre this afternoon Mr. Gest had intended leaving New York in time to be here. Of course, all there is to the lecture is simply an illustration of underground construction that is actually done, and we are giving it by moving pictures. Of course the why and wherefore of putting wires underground is familiar to every one, and we know that a number of companies are agitating putting wires underground as soon as they can see their way clear to do it. They are prompted to this by a number of reasons, and it is simply keeping up with the times. Those who keep most abreast of the times are the men who are ahead in the race. One thing has just come to my mind, namely, the Standard Oil Company's pipe line. They have a trunk line running from the oil fields of three tewlve-inch pipes. They have under ground between 15,000 and 16,000 miles of 8, 10, and 12-inch pipe to conduct their oil, and through those arteries they deliver into Philadelphia and New York 145,000 barrels of oil per day. That simply goes to show that they are keeping up with the times, and notwithstanding strikes or anything of that kind, they can get the oil when they want it. In the United States to-day there is 67 per cent. of all the telephones in the world, and the Bell Telephone Company has its trunk lines underground from Boston to New York, from New York to Washington, and from Chicago to Milwaukee, a total distance of somewhere about 600 miles. That is what they have done to keep up with the times. Apart from this my talk with regard to putting down electric light wires underground will be on the screen.

Mr. Stannard then showed, by means of moving pictures, the construction of underground conduits for electric wires in different parts of the world and under various conditions. He showed the workers at work in various capacities, and different kinds of cable being laid. He showed some scenes illustrating overhead wiring in Montreal, several pictures showing where the wires had become tangled through poles being broken. He also showed a picture of the Shawinigan Falls Power Plant.

The President: As the time has arrived when we have to leave the theatre, we will now adjourn to the hotel where the discussion of Mr. Stannard's lecture may take place.

The meeting then resumed at the Chateau Laurier and the President called on Mr. McAllister Moore, of Belleville, to read his paper on "Commercial Electric Heating."

COMMERCIAL ELECTRIC HEATING

McAllaster Moore

One night last fall I was sitting in a decidedly chilly hotel lobby, listening to the general conversation, which finally turned on the subject of electricity, and in the course of the discussion one man made the statement that before many years we would see every house in Ontario being heated by electricity.

When I ventured to dissent from this proposition, I could see that the prophecy had many believers, and in view of all the publicity that has been given to electricity throughout Canada in the last two or three years this fact is not surprising.

In my estimation, electric house heating will never become in any degree popular and this can be demonstrated in a very simple manner.

By far the commonest form of disseminating heat is by steam, and in general it requires 3 lbs. of coal to generate one boiler horse power. To get the same power with electricity it is necessary to use 10k.w. hours, and to bring electricity and coal to an even cost basis with coal at $5.00 a ton it is necessary to sell electricity at 1/15 of a cent a k.w. hour, or $4.38 a horse power year, for in a heating proposition, at least in Canada, you have got to assume that power so used will be purchased by the year, as no concern could under the circumstances afford to sell it on a k. w. hour basis. This seems an absolutely prohibitive figure, yet commercial electric heating is already very wide-spread and is growing rapidly.

In the May number of the ''Electrical News'' an account was given of an entire building being heated by electricity, and there are numerous installations scattered throughout the country. So while it is perfectly true that at first glance it is absolutely prohibitive in cost, there are many other factors which enter into the situation and render it not only possible but under some conditions eminently economical. There are plants where an economy of 3 lbs. of coal per horse power hour may become 6 lbs., and where the cost for coal may be $10.00 or even higher, in which case your equivalent power rate is $17.00 or more per horse power year. Add to this your expense of attendance and fixed charges on the plant and you easily arrive at a figure of $25.00 per horse power year, which rate is in some cases quite within the range of possibility, though still not a commercial factor. Now, find some other use for your power for 5 months out of the year and you are getting to a point where you can talk real business.

But after all it is only in cases where there is a wide and steady market for electricity for commercial purposes that we are interested, and all discussion would be purely academic except when considering some very special condition.

And here let me say a word as to estimates in the heating business in general, for in my experience there is nothing more unreliable. I have known propositions that looked eminently feasible on paper and which failed lamentably in practice, and propositions which looked like a wild dream, to work out beautifully. While most things can be reduced to equivalent B. T. U. between electricity and gas or electricity and coal, even this cannot always be relied on. Take as an example an oven, the number of units necessary to heat the charge to the desired point may be small, and the cost for these units alone, offset against convenience, cleanliness and reliability of control, may make the proposition very attractive, but some point in the construction of the oven may introduce totally unexpected results; for instance, not long ago the writer had occasion to figure on installing an oven for baking biscuits, very light in weight and taking up a very small number of B. T. U., but unfortunately the biscuits were placed in pans on an endless belt and sent through the oven in this way, and the pans themselves absorbed seven times the B. T. U. of the biscuits, making the thing absolutely impractical. In cases of this kind one cannot be too careful in collecting all the data available.

Probably the most important commercial use of electric heating is in laundries and tailor shops, and here I do not believe that the cost of current is a factor of any importance. The quality of the work and the speed with which it may be performed and the time saved by the operator far outweighs any question of current. So far as the revenue of the central station is concerned a rate of 3 cents per k. w. hour to a laundry is equivalent to a motor rate of $67.50 a horse power year on a 10-hour a day basis with an added advantage of having 100% power factor and pretty close to 100% load factor, if the laundry is well operated. One tailor's iron is a little more than the equivalent of a one h. p. motor in current consumption. It is the writer's opinion that under these conditions a tailor's shop employing five or six ironers should earn a far better rate than they do.

In making an installation of this kind, however, nothing is more important than to get it right in the first place. The laundry or tailor's iron is out of use far more often because of a broken cord than because of a burnt-out element, and it is no more satisfactory to operate such an iron from an ordinary lamp socket or wall plug than it is to operate a lathe without a counter shaft or a motor of any size without a starting box. Cord repairs aside from the annoyance they cause, are expensive. There is no one in the shop who can attend to them and they are always needed at the rush hour.

A good installation should consist not only of the iron, but of some suitable cord support, a permanent and serviceable wall switch, and especially in large shops, a pilot lamp whereby the foreman can tell at a glance which benches are busy and which are idle. The additional cost, though it may be considerable in some cases, is money very well spent. I have one concern in my mind where such devices were installed, the factory capacity being 300 irons, and an exceedingly careful cost system showed an average repair expense of 3½%, and this too for a period of over eight years.

A glue pot probably comes next in point of usefulness. There are numerous types on the market, enough to give a wide variety of choice as to style, price and size, from the little ½ pint pot for the piano factory use with a running current of 50 watts to the big 30 gallon glue pot consuming from 7 to 10 k. w. Aside from convenience and portability the principal argument in their favor is the absolute elimination of the fire hazard, and the necessity in most plants where steam cookers are operated, to keep up steam during the summer months when it is not needed for heating.

So far as I have been able to find out by talking to glue manufacturers and large users, the water jacketted pot is much more satisfactory than the other type, and though glue in a dry pot may apparently be all right, it is apt to give way at the end of a few months. I make this statement without proof, nor do I know of its susceptibility of proof or disproof, but that it merely is a statement that has several times been made to me.

The electric solder iron, which in spite of many statements to the contrary has never been adapted to heavy and continuous work, still has a large field, especially in telephone work, and one should be on every meter man's bench in every central station.

The solder pot also has its uses and may be adapted to many metals besides solder. In this connection I might state that I have had numerous inquiries for heaters for linotype machines, and while my company and others have built such machines they have not proved a success, owing to the high melting point of type metal, which necessitates an exceedingly high temperature heating element. The difficulty is to give such an element a satisfactory life.

The sealing wax pot is a great convenience in banks, express companies, etc., and the electric pitch kettle in brush factories and places of similar nature may often be used to advantage.

The above list about covers the range of standard devices, but in addition to that there is a large field of special devices, which are rapidly becoming standard. Foremost of these is the electric baking oven, and this is an article which should receive a great deal more attention than it does. In the first place it forms the most desirable load that the central station could possibly have. The oven is ordinarily used

between 12 at night and 6 in the morning, when all other business is practically at a standstill. The oven itself being made of sheet iron is lighter in weight and generally runs at about one-quarter the price of a brick oven. Absolutely uniform results from one time to another and between the highest shelf and the lowest shelf in the oven may be attained. The bake shop is not limited to the ground floor by reason of the weight, but the electric oven may be placed in any convenient place and occupies about one-fifth of the floor space of the brick oven. The average current consumption is 80 watt hours for a one-lb. loaf; no attention is necessary, and the control is simple. The oven will turn out its batch of bread every 35 minutes once it is heated up, and may be depended on to work to the satisfaction of the user. The operating cost and first investment being low, there should be a very wide field for these ovens. The largest installation which the writer knows of is in Skiles bakery in Milwaukee, where there is a capacity of 500 loaves at one baking, though 80 to 100 loaf ovens are quite common.

There are many cases where some special operations may be economically and advantageously carried on in an electric oven, such as japanning of small metal parts and firing of certain classes of paints and enamels. In the case of the delicate work it is possible to build the oven controlled in such a way that one can work to any desired temperature curve inside from start to finish. Last fall the writer installed such an oven in Trenton, Ont., having 12 points of control, and consuming 30 k. w. on the maximum heat.

The same factory installed an electric welder at a saving in labor cost of about 3% in the manufacture of its product. As the total power cost of the average machine shop is 2% of the cost of the finished product, it will be seen that the cost of current, in cases of this kind, is in reality unimportant.

Perhaps the water heating question is the one that most frequently gives trouble. The ordinary warm bath consists of about 30 gallons of water at a temperature of say 110 degrees F., which means at least 60 degrees of temperature must be added to the hydrant water, and as it takes 3 watt hours to raise one gallon of water one degree, it will be seen that the minimum requirement for such a bath is about 5½ k. w. hours. As it is scarcely practical to connect a greater load than 2 k. w. to the ordinary service, it means about two and one-half hours of time to get sufficient hot water and an almost prohibitive cost. On the other hand, such a heater running 18 hours a day will furnish 5 or 6 baths, and 4 k. w. or about 6 horse power running 24 hours of the day at $30.00 per horse power year will take care of an apartment house of ten or fifteen families very nicely, at an exceedingly reasonable cost per annum.

For the individual householder I do not regard bath water heating as practical except in connection with a range. I have occasionally installed a range having a maximum demand of 3 horse power and a

water heater with the same demand with a double throw switch between, current being sold on the horse power year basis, and where a price not to exceed $40.00 per horse power year can be obtained, all the cooking and hot water necessary for the house may be had at an expenditure of $10.00 a month. If you will compare this with the ordinary gas water heater and gas range you will very often find a distinct saving in favor of elecricity. One reason for this is because there is almost always a good deal of waste in the hot water supply of the ordinary house, the water in the boiler gets hotter than is necessary and leads the user to waste it to a very large extent. I recall a case where five bathrooms were to be supplied from a 160 gallon tank and consuming about 15 tons of coal at $7.00 a ton. Two 2 k. w. heaters were installed connected to the boiler in multiple, but the full capacity was found to be unnecessary and the total consumption was cut down to 5 horse power, the rate being an exceedingly favorable one of $20.00 per horse power year; the installation was found to be actually cheaper in operating cost than coal.

In the line of apparatus nothing remarkable has developed. The immersion type heater has always proved satisfactory and efficient and several firms are manufacturing it with various details. Our company are now constructing water and steam boilers, with a series of tubes very much like a tubular steam boiler, each tube being an independent heater and capable of having the element removed for repairs without shutting down the heater.

Several new devices have also been placed on the market, but they are for the most part merely refinements of old designs. It is not often that we get anything new and radical; but new uses are developing for existing goods every day.

So much for the apparatus itself, but there are one or two points I should like to bring out with regard to the selling of it. The manufacturers have made great strides in the last few years; many devices that were unsatisfactory a short time ago are now much improved and can be relied on to give good results. At the same time in approaching a customer the whole thing is totally new to him, the apparatus is more delicate than the type he has previously employed, and it may in many cases be necessary to change certain processes to conform to the new type of apparatus. There has been a great deal of over-confidence on the part of the salesman and in many cases it has led to a distrust on the part of the public, which it is necessary to overcome.

Aside from all question of selling ability on the part of the solicitor, he must be firmly convinced, both from previous known experience with the device and from a study of the prospective buyer's own business, that it is thoroughly advantageous to him and offers in some way an increase in his profits.

The President: This is another contribution to the literature on electric heating which is instructive and interesting. One point which struck me most forcibly in Mr. Moore's paper was the statement to the effect that we must distinguish between theoretical claims, or claims based on theoretical consideration, and on actual practical results Many papers have been published in which it has been stated that electrical energy at a certain price per kilowatt hour will perform certain operations, competing with gas at a certain price. But when you try it you do not get near it. The explanation lies in the fact that the man who made these claims was probably figuring on theoretical considerations, taking so many B.T.U.'s as being required to perform a certain operation, and so on. When it comes to be tried, however, it seems to take a great many more B.T.U's, because there are all sorts of sources of waste that were probably not considered. I made an experiment in my own house with a view to satisfying myself about certain things. I had been using gas for cooking for several years, and I knew what it cost me. One month did not vary much from another. I may say I was paying for gas on the basis of $1 a thousand feet, and it seemed to me that at that price there ought to be a chance for electric cooking. Now, there was nothing in the house to cook with except gas, and, therefore, all our cooking was done in that way. An electric range fitted to do all sorts of cooking was put in, and the gas stove was disconnected and put aside so that it could not be used. I wanted a practical test. The range was put in and things seemed to go on just as usual, and the cooking seemed to be about the same as before. At the end of the month the range was taken out. The people in my house did not like it as well as the gas stove. I told them this might be prejudice, but the gas stove was put back. Now, taking the record of the meters I found that in order to compete with what I had been paying for cooking with gas at one dollar a thousand I should pay the electric company a rate something like one and a half cents per kilowatt hour, or a little over that. Of course, where gas is much cheaper, the rate for electrical energy would have to be correspondingly less. The outlook does not seem very promising for the adoption of electric cooking in any general way, except for reasons other than the cost of it, such as convenience, cleanliness, and so forth. As a matter of cost, it seemed to me that in some places they would have to sell electrical energy at something less than one cent, certainly not over one cent.

Mr. Kemble: What was the load factor?

President Dion: It was very poor. There is a very high peak three times a day. The peak was one feature that was remarkable. It took as much as five kilowatts at one time to carry on the cooking operations as we had been accustomed to. Of course if you were trying to keep down the peak you could so arrange the cooking operations as to keep it down. Whether the average maid or cook could do so, I don't know, but we did not try to do that. We went on in the good old way, and

that meant that at certain times when preparing dinner the load went over five kilowatts, so that the load factor was very, very poor.

Mr. Moore: That question of load factor to a certain extent, though not entirely, can be taken care of with the design of the range, In contra distinction to your experience when I had my range wired up the electrician carelessly put in 20 ampere fuses and I never had any trouble. If I may take up a few minutes of time I may say that in the ordinary family ninety-nine times out of a hundred broiling and baking are not operations going on at the same time. You are either broiling something for dinner or you are baking it, but it is very rarely you do both, and in some ranges where the broiler is separate from the open you don't get them both.

President Dion: What do you think of a five kilowatt load as a peak? Is that the ordinary load, or is it excessive?

Mr. Moore: Well, I didn't get it myself. So far as the cost goes that is a very variable factor. In my own family we have had the usual domestic experience that most people have in small towns of changing servants almost every three weeks, and I have noticed a difference of two or three kilowatt hours a day between one domestic and another. I have noticed also that the same girl when she understood the matter would cut down the consumption a good deal.

President Dion: The average girl doesn't study the situation.

Mr. Moore: My average load is twelve hundred watt hours per person per day, that is, taking a period of about nine or ten months.

Mr. Grant: How does the cost of running your electric range for house purposes compare with the cost of gas or coal?

Mr. Moore: Coal of course is quite a bit cheaper. I should say that two and a half cent electricity will practically compete with dollar gas. I don't know what the B. T. U. of the gas in Ottawa is, but it varies very much. I think the majority of plants in Canada will give about four hundred and twenty-five or fifty, especially in the smaller towns.

Mr. MacLachlan: I think we have to thank Mr. Moore very much for going into the matter in the way that he has done and for his frankness, especially in the first part of the paper. As for the problem of heating a house with electricity, although it is possible under certain conditions, generally speaking, it is out of the question. With regard to cooking by electricity I can give a little personal experience. All the cooking in our house is done by electricity, and I have checked up the bills worked out on the three-cent rate with the bills of some families in the town using gas at $1.25 a thousand, and my bills are lower than that rate. The gas is four hundred and twenty-five B.T.U.'s. I think the Government could, with a great deal of fairness to the electrical profession, look into the B.T.U.'s in the gas question. As far as the range itself is concerned the type of range with a clamp utensil is, I think, the range to consider. The use of proper utensils should also be considered. To use the average utensil on an electric range is not treat-

ing it fairly because you are not getting the contact which is necessary for the best service. The ideal combination from the central station, as well as from the cooking standpoint, is to have the hot water heater and the range installed as one installation, putting the double throw switch in between. With that combination you increase your daily load factor a great deal. When you are cooking you have the circulation heater off, and when you are not cooking you have it on, and that gives about enough hot water for the average family. Of course if there are more in the family and more water is used you will have to step up to medium and possibly to high, for a few hours before washing. I may say that all the washing for the family was also done on the electric range except a few things which were sent out. I think Mr. Moore has brought up a very good point in speaking of the tailor's iron as being equivalent to a one-horse power motor. It is an easy matter for a solicitor to place an iron or a toaster in a house, but we do not always recognize that a kilowatt is a kilowatt no matter what it is used for, and I think the use of electric heating propositions in the industrial field will be looked into a great deal more than has been done in the past.

Mr. Kemble: Mr. President and Gentlemen: It is a great relief to hear a manufacturer or agent for any electrical appliance not claim for it the wonders of all the combined patent medicines. With the extremely low rates which we are now enjoying it would seem necessary to pay a great deal of attention to the development of any kind of business which would take current from our lines during the night hours. The combination water heating and cooking system, if put in purely as a cooking and hot water system, would seem to offer some hope along this line. One point appealed to me particularly, and that was the necessity of getting reliable data. Mr. Moore and I attempted to fit up an anealing oven last winter for one of our manufacturers, and the description given us of the oven was that it was carefully insulated with two inches or more of magnesia with an air space outside. On that understanding we recommended a certain apparatus and quoted a certain rate. When the heating apparatus came to be installed after the oven was finished it was found there were some three or four hundred quarter-inch bolts running from the inside sheet-iron through the magnesia to the outside sheet-iron. A very few minutes' calculation will convince you that the oven was not a commercial success, and I regret to say they are now using gas. I have done considerable experimenting in regard to cooking, and the figures per person per meal would appear to lie between nineteen one hundredths (.19) of a kilowatt and about six-tenths (.6) of a kilowatt, so that I think Mr. Moore's figures of 1,200 watts per person per day (which is equivalent to four-tenths of a kilowatt per person per meal) would be a very fair average. On one point I must decidedly disagree with him, and with the last speaker, Mr. MacLachlan; that is, on the question of having to use any special kind of utensils, such as clamped on dishes, or anything of that kind. I realize perfectly the superiority of a clamped-on dish, but besides the load

factor and the power factor we have the domestic factor. I would like to ask Mr. Moore whether any attempt has been made to use the water heating systems on the thermo principle by using a unit with takes a small amount of power, but which is left on for twenty-four hours per day. I have had some experience with fuses, and I must say I think Mr. MacLachlan's and Mr. Moore's fuses are the exception rather than the rule. I think we will find Mr. Dion's experience of between three and five kilowatts' demand is much nearer the actual demand which we would have to supply.

Mr. Moore: Your question on the thermol principle is very well chosen, Mr. Kemble. In England that system has made considerable headway. The storage capacity of cast-iron for heat is very good, but on the other hand, it is a rather expensive thing to instal to get a capacity that will take care of the average family. You have to have an immense amount of cast-iron, and I think some of their heaters weigh about three-quarters of a ton. Our practice has always been to store in hot water with the ordinary range boiler, and an asbestos jacket, and we figure on a total radiation loss not exceeding fifteen per cent. of the energy used in that way, which is really not serious. You can lose fifteen per cent. in almost anything you take up, so that while the therol system is very good, I do not think the saving warrants the expense. Now, with regard to the locked-on utensils, that is the objection that is made everywhere I go. I would reply to Mr. Kemble by saying that I wish they could show me something better. We get an increased efficiency of at least 20 per cent. with a locked-on utensil, and, when the time comes that current is sold so cheaply that that 20 per cent. has no value, then it will be time to discard them, but I don't believe that time has come yet. I would like to cite the City of Victoria, B.C., with, to my knowledge, over one hundred ranges all operating on a five-cent rate, and more going in all the time. There the cost is governed solely by labor conditions. In Victoria the cooking is done by Chinamen, and when they can get them they pay them $40 a month, and electric energy is cheap at any price.

Mr. Kemble: I was not questioning the efficiency of the locked-on apparatus at all, but I was merely questioning the advisability of it with the class of help we have.

Mr. Moore: Nobody would like to get away from the locked-on utensil more than we would, because it adds a great deal to the expense, but at the same time I do not believe that it is as difficult to instruct a domestic in how to use it as Mr. Kemble thinks.

Mr. Thomas: May I say a few words on this subject as a manufacturers' representative? There is a point that is lost sight of very often in comparing cooking by electricity with cooking by gas and coal; that is, the waste in cooking electrically is very much less than by cooking with gas or coal. My Company have made some experiments in that direction, and they find that the loss when cooking with coal or gas is about 28 per cent. when the operation is finished. When cooking

electrically in a well-constructed stove you can bring that loss down to about fourteen per cent., and that is a very big item.

Mr. Hornby: Illustrating the speaker's last point, it may be of interest to the members to know that in England this point has been very much emphasized. We have huge street posters in a somewhat humorous vein. They show an electrically-cooked joint in a very fat, healthy condition, and a gas-cooked joint in a shrunken-up condition, and so bring the fact home to the layman that electrical cooking does save him something.

President Dion: Why is that, Mr. Thomas?

Mr. Thomas: I suppose the heat is more uniform. There is absolutely no doubt about what has been stated. It has been tried time after time. You retain the juices in the meat by cooking electrically where it often runs to waste the other way.

Mr. Moore: It is a question of ventilation.

Mr. MacLachlan: It is the same with paper-bag cooking. The electrical cooking seems to be the ideal way.

The President: The subject of electric heating and cooking is one which will be a live one for some time to come. I am sure we have all appreciated Mr. Moore's contribution very much.

The next item on the programme is a paper by Mr. T. F. Kelly of Hamilton on ''New Business.'' I believe he has something which will be most interesting.

NEW BUSINESS

By Thos. F. Kelly,

Contract Agent, Hamilton Electric Light and Power Company.

So many valuable and interesting papers have been prepared and read at different electrical conventions on the very important subject, entitled "New Business," that it was with some hesitation that I accepted the invitation to prepare this paper.

To my mind, to be successful in the New Business Department of an electric light or power company, or any other industry, one either has to be a "wonder" in creating new schemes and methods for securing new business and being careful to retain it, or be ready to adopt the schemes of others that are workable in his territory, know how to put them in operation, and then hang on to the business thus secured.

It is not my intention to steal any person's thunder, and claim that all the ideas and schemes mentioned in this paper are my own brain throbs. It is possible that some gathered in this room will recognize some of the "dope" handed out; therefore, if such does happen and the charge is made, I will plead guilty and admit that I have adopted in my business many another man's ideas. For that reason I am here to-day, hoping to learn other ideas that I may adopt, and if I repeat any such ideas, I do so with the hope that the members of the electrical industry will benefit.

The Sale of the Commodity.

From the commercial standpoint, we must regard the sale of electricity just as the merchant regards the sale of any commodity with which he undertakes to supply the people whose patronage he seeks. You can put it down as a fundamental principle of successful merchandizing that the article or service to be sold must meet the expressed or latest needs of the people to whom it is offered, and that its use must be of real value to those who purchase.

As to Rates.

While the price of the commodity being disposed of by this Department should be such that on the one hand it will afford a reasonable profit when the risk of the business and inherent value of the commodity are considered; on the other hand, the rates should not, for the success of the business, be so excessive as to largely limit its volume.

Secure Profitable Business.

It is essential, for the success of the New Business Department, that the business sought for should be profitable. By all means let the "other fellow" have the unprofitable, and that only.

The very interesting paper on this subject, read at the Convention of this Association last year by Mr. Parker H. Kemble, dealing particularly with the importance of securing profitable business, is still green in our memories I will not attempt, therefore, to further impress on your minds the necessity of securing this class of business.

I know of electric light and power companies, having a monopoly in their territory, adopting rates by which they figured that all business secured was profitable and yet fair and equitable to the customer, as these rates had included fixed or minimum payments which they knew would cover their readiness-to-serve charges. Under these conditions the solicitor did not have to worry whether the business, power or light, for which he was striving, was profitable or unprofitable for his company.

However, under the competitive conditions that exist in many cities and towns in Ontario, that condition is ceasing to exist because our friends, the municipal competitors, in most places, do not seem to care whether the particular business they are seeking is profitable or not, so long as by "hook or crook" from the statement of that department at the end of the year, whether by neglect to keep books properly or otherwise, municipal ownership can be shown to be a success.

Good Service Should be Given.

It is necessary, for the success of an electric light and power company, to provide a station equipped with sufficient and reliable apparatus, an adequate system of distribution, well regulated potential, and a competent operating and business organization.

While the supplying or delivering of "electric service"—the commodity the New Business Department is disposing of is not one of the duties of the particular department this paper is attempting to treat of, it is absolutely necessary that a successful department depends on good service being supplied at all times.

This includes prompt attention to the connecting of the customer's premises by the Construction Department; to the installation of the meter and lamps by the Meter Department; to the monthly meter reading being taken, if possible, by the meter reader, and proper notice for this purpose being left, if unable to secure a reading; to the account being rendered promptly; to proper handling of customer's complaints and delinquent accounts by competent employees; to suitable arrangements being made for handling of all lamp renewals, etc., and, above all, courteous treatment of all visits and telephone calls from customers.

The New Business Getters.

The head of the New Business Department and his solicitors are a necessary factor in the growth of the business, and in the success of the Department. Because the men of this Department are on the firing line of the progress of the company they represent, it is necessary that they should so conduct themselves and perform their duties that they will advance their company's interests at all times. Much care, then, should be taken in the choice of the men of this Department.

To my mind, the most successful solicitor is the one who feels thoroughly the responsibility and dignity of his position. Such a representative will use every means in his power to reflect credit upon his company; he will note carefully all minor details, as well as those of major import, and he will endeavor to acquaint himself with the full nature of his proposition before approaching his customer, and, above all, he will not allow false pride or fear of appearing unduly ignorant to deter him from asking questions of his superiors; the failure to do which may tend to a necessary display of ignorance and to his discredit in the eyes of the customer.

In any event, the solicitor must have some special aptitude for the work. The more the better. He should be a fair judge of men, a man of good business address, an enthusiast in his work and loyal to his employers.

The Duty of the Department.

I can almost hear the members say: "Why, to get business, of course!" Well, to that I am going to add—"retain it."

While it would be a great deal easier for this Department to be relieved of the last mentioned duty, I believe it is essential, for the success of the business, that the man who secured the contract have an opportunity, in the event of any complaints arising and there being a possibility of the contract being cancelled, of getting in touch with the customer and holding the business for the company.

It is the duty of the men of this department to call on everyone who may be regarded as a prospective customer and endeavor to increase either the interest or curiosity which they have manifested to a point where a contract is signed, or a sale made.

What the Solicitors Should Know.

The person in charge of this department, and his subordinates, should be entirely familiar with the class of business they are endeavoring to secure, with the territory they are supposed to cover, and be acquainted with what has and will happen in that territory.

There are many ways of obtaining this latter information; perhaps the most successful is by connection with all local Associations where the opportunity is offered of getting in close touch with the proper men in the different territories, which will result in tips being

secured, to be followed by the closing of contracts for additional business.

Divide the Territory and Business.

The solicitors of this department should have a particular territory or a class of business to take care of. This arrangement depends on local conditions entirely, and no arrangement can be made as to the division of territory and business that would be workable everywhere.

Where possible, the business should at least be divided as follows: A solicitor should be assigned to a particular district, and should be responsible for the securing and retaining of the particular business he was supposed to be taking care of in that territory, whether of electric power, lighting or appliances.

How the Office Should Help.

The solicitor, without proper assistance from the office of his department, cannot be expected to work with the greatest efficiency.

Special care should be taken that all enquiries for service in the different solicitors' territories be turned over to them as soon as received, and, to further assist, the telephone number of the enquirer should be obtained, if possible, to enable the solicitor to get in touch with him and make an appointment.

The daily reports as turned in by the solicitors, containing complete record of all calls and their results, made the previous day, should be gone over very carefully, and proper memorandum taken of future visits to be made by the solicitor. These memorandums should be properly filed and turned over to the solicitor on dates specified.

Upon being advised by the solicitor, regular forms or special letters, as the occasion requires, should be mailed promptly to prospective customers.

The office should keep an up-to-date system regarding the possibilities of securing any class of electric light or power business in the territory.

Advertising Should be Conducted.

Many electric light and power companies endeavor to secure business without the use of newspaper space and other mediums of advertising. While I do not intend to lay out any plans in this connection, I wish to state that I consider that our business, to be successful, should receive similar treatment to any other successful one, and what successful business has not received its share of publicity?

Before embarking on any particular campaign for a certain kind of business, be it electric signs, electric vehicles or electric irons, I believe that an advertising campaign should be planned and adhered to.

The particular medium of advertising to be used is not standard —this depends on the nature of the business to be secured, the class of people desired to be reached, etc.

In choosing your mediums, remember the electric sign. Erect one different from any other in your town. It will repay you.

When advertising, be honest, and say one thing at a time.

In addition to the proper use of all advertising mediums, do not overlook what is known as "favorable publicity." Be a good friend of the newspaper men, and, when you have something to interest the citizens of your town, tell them. These men are always looking for news, and I have secured double column headed front page articles in this way that have been an immense help to the solicitors, and an introduction to the advertising matter sent out.

The mediums that can be used in our business are many. Among these might be mentioned electric signs, illuminated billboards, street car cards, monthly bulletins, newspapers, etc. They all have their particular uses and advantages.

Do not forget follow-up letters. This medium can be used at all times, and good results secured.

By all means, do not expect the solicitor to get the proper share of the business to be had without advertising being used, nor the advertising, to produce results, without being properly followed up.

Regarding Getting Business.

To secure the electric light and power business in any locality, the New Business Department must be alive at all times, and use every workable legitimate method toward securing the business.

A rough plan to follow to secure the lighting business is to be in direct communication with the Building Inspector's office, to get the list of permits to erect and alter buildings. Then get in touch with the architect, contractor or owner of the building to see that the premises are wired, and wired properly. By wired "properly," I mean —to enable sufficient lighting to be secured, and, should it be a dwelling, that base board receptacles are arranged in the different parts of the house, to enable the many labor-saving electrical devices to be used most conveniently. And then, after it has been decided who is to occupy the premises, get in touch with that party and "stick" until the contract is secured.

In securing power business, in addition to keeping after the present steam and gas engine users to convert them into using electric motors, to learning of new manufacturing businesses being created, be actively connected with your "Board of Trade," and a friend of the Commissioner of Industries for your city, to enable you to assist in bringing new industries to your town.

I will now, under headings of Electric Power, Commercial Lighting, Residence Lighting, Electrical Advertising, and Electrical Appliances, offer some comments on the securing of these different classes of business.

Electric Power.

Persistent work on the part of the power solicitor is required to secure the business he is particularly interested in. A card system of all prospective customers should be made, an excellent follow-up system by letter should be used and frequent calls made by the solicitor to secure this business. The solicitor should be prepared at all times to ''show'' his prospective customer the cost of the use of electric service as against other sources of power supply. Keep calling on your man; you will make a visit some day when his engine is out of order, and although your ''man'' may be ''hot'' under the collar, your suggested installation of electric drive will be accepted.

In addition to keeping in touch with all prospective power consumers, know when any person decides to start a manufacturing plant in your town, and get after the business at once. A letter, offering assistance to them in deciding the motors they will require, etc., will put you in ''right'' and be of considerable assistance toward securing the contract.

Then, this Department, through its head, should become one of the builders of the town in which it is doing business, by taking an active interest in the work of the Board of Trade and furnishing information for them to all concerns thinking of locating in your city. In Hamilton, we have been co-operating for years in this work, and you all know the many concerns of Canadian as well as of American origin that have located in our city and have become customers of ours. Such a concern not only means the addition of a power customer, but, as the employees require light in their homes, the possibility of adding a large number of residence consumers.

Commercial Lighting.

The big feature in commercial lighting of late has been what has become known as the Tungstolier campaign. This campaign consisted in the selling or renting of fixtures, equipped with the proper reflectors and Tungsten lamps, to secure efficient lighting for the customer. In Hamilton, our Tungstolier campaign is conducted on a rental proposition only. Under this proposition, providing the premises are wired, we install and maintain these Tungstolier fixtures equipped with Holophane or Alba reflectors, and sixty or one hundred watt Tungsten lamps. The rental and maintenance charge depends on the size of the fixture, whether it is equipped for one, two, three or four lights. This charge includes the installing and maintaining, the maintenance consisting of periodical visits by an inspector for the purpose of cleaning the fixtures and reflectors, and changing burned out lamps. This proposition has been a wonderful success in securing business. Some time ago we had a special fixture made suitable to use with the 200 candle power Tungsten, which we now supply on a rental basis. To secure additional business on our commercial lighting circuits, we have also

had suitable fixtures made for doorways and exterior store lighting. This fixture also is installed complete on a rental and maintenance proposition. All of this business is taken on three-year contracts, and these propositions have been the means of our securing practically all of the new store lighting in our city, and, in addition, long term contracts with many old customers who had inefficient lighting systems, and of replacing many gas arc installations.

Residence Lighting.

Practically all new houses built near where an electric light service can be secured are wired, and yet there are many homes on our lines to-day that require to be wired and supplied with fixtures, to enable the tenants to become electric light users.

To secure residence lighting in Canada, more soliciting is required than in the United States. I have been informed, and I understand it is true, that in the United States the landlord or owner of the dwelling installs the lighting fixtures, while here in Canada the landlord has not been educated to do so, which means that the tenant has to be approached in many instances to purchase fixtures to enable him to use electric light. In Hamilton, we are endeavoring to complete their education along these lines, and some builders, I am glad to say, have started to do so; however, there are many homes wired but still waiting the installation of fixtures for the reason of the inability of the occupant to finance the purchase of the fixtures outright, and the inability of many fixture stores to carry many such accounts. To secure the business of the unwired house and the house without fixtures, one plan has worked successfully, and that is the wiring of houses and the supplying of fixtures on the instalment plan. Before putting such a plan into execution, considerable thought should be given to the question of its effect on the wireman and fixture store and, as far as possible, co-operate with the parties affected. Instead of purchasing these fixtures direct from some manufacturer, and having your men do the wiring, you might possibly allow the contractor to do the wiring and purchase the fixtures from him, paying for same upon completion or delivery, and allowing the customer to settle with you by monthly payments. In the event of more than one wireman being in your town, settle a price which you know to be fair at so much per outlet, switch, etc., and then notify all these contractors of your intentions, secure their co-operation, and then distribute the work amongst them. Many managers have side-tracked a proposition of this nature, and yet, think of the many homes that have been purchased and furnished by similar methods.

Special care should always be taken to see that a house once connected contains a customer. With good service at fair rates the customer will, in most cases, continue, but should he vacate, every possible means should be used to secure the business of the new tenant. To this end, postcards should be left in prominent places in the empty

houses when the meter is removed, for the new tenant to send to the lighting office, stating that they had moved in. Key tags, with suitable advertisement on them, have secured results from being left with the differ ent real estate men.

Electrical Advertising.

To my mind, to secure the maximum amount of this class of business, the central station has to have a rental proposition to offer the customer, to have him use electric signs.

It has been my experience that there are many merchants perfectly ''good pay'' who will sign contracts for such a proposition, whereas they will throw up their hands in horrors at the suggestion of paying $100.00 or thereabouts for a sign, and become its owner.

To secure the electric sign business there are many methods along this line.

A central station might co-operate with a sign manufacturer and agree to purchase all signs that they may secure lighting contracts for, and an agreement from the central station for the purchase of the sign in monthly payments spread over one, two, or three years. In this case the customer would own and maintain the sign.

Then, again, the central station might agree to purchase all signs that the solicitor of the sign manufacturer might secure contracts for covering the lighting of such signs and their maintenance. Under this proposition the central station would own and maintain the sign, the amount in the contract signed by the customer being a rental covering all charges. Under this proposition, care should be taken by the central station that the words in electric lamp letters be standard, such as ''Shoes,'' ''Drugs,'' etc., to provide for the sign being used at a different location, if found necessary, by simply re-painting the body of the sign.

Both these propositions, I understand, have been used by different central station with success. In Hamilton we are conducting a campaign with the Federal Sign System (Electric), which has secured us considerable business. Under this proposition the sign company owns and installs the sign. They do all the advertising and soliciting in connection with the proposition. The agreement between the sign company and the central station is one whereby the central station collects the accounts, maintains the signs, in addition to furnishing the current, and the sign company pays the central station for this service. The amount mentioned in the contract between the customer and the sign company is a flat rate covering the furnishing and erection of the sign, lighting and maintenance. Bear in mind, the sign always remains the property of the sign company.

Electrical Appliances.

The sale of these appliances and their consumption of current can be secured by many methods, and the combining of many. Special

solicitors, preferably women, can be employed to go from house to house and sell, by demonstrating the practicability and simplicity of current-consuming devices.

A display or demonstration room in which the apparatus can be shown in actual operation is another excellent channel for the disposal of these appliances.

The putting out of irons and other appliances on trial is a well known plan that is now used by practically all central stations.

Do not be satisfied when a customer uses your current for lighting only. Sell him electrical appliances and he becomes much more valuable as a customer.

The President: Mr. Kelly has written a very fine paper. It did not surprise me in any way, because I expected a fine paper from him. Last year he made a valuable contribution to the discussion at Niagara Falls on a similar subject, and we always look to him for some advice on mattters of that kind. How to secure and hold business and what is the most profitable business are subjects in which we are all interested. No matter how perfect our engineering departments may be they will not be of very much service unless we can sell our product on the market.

Mr. Kemble: Mr. Chairman, I have been very much interested in Mr. Kelly's paper, and I think, possibly, I can best express my appreciation of it by saying that my position on the Committee of Papers enabled me to get a considerable number of advance copies, which I distributed amongst some of my men, as I thought it was a paper which every one of the solicitors should read and study. Several points that Mr. Kelly has taken up rather appeal to me, and one is the question of service. I wonder sometimes whether the engineering departments which Mr. Dion feelingly referred to realize how much the maintaining of service and the prompt handling of interruptions reacts directly on the ability of the sales department to hold and get new business. I say "hold" advisedly first, because in view of the municipal undertakings which are at present going on in Ontario the question of holding is a very serious one. As regards advertising, I know of no place where more money can be spent and smaller returns obtained than in a misdirected advertising campaign. On the other hand, newspaper advertising, if the copy is properly chosen and changed, is most effective. One line of Mr. Kelly s paper in particular appealed to me. When advertising, be honest, and say one thing at a time. So many advertisements seem to be laid out along the lines that a man is paying for so much space, and the more he can possibly crowd into that space the more he is getting even with the newspaper he is paying. Now, I think it can be stated practically without demur that if you can get one idea into the head of the reader of your advertisement that advertisement is paid for, and everything you do which endangers his grasping that one idea clearly, distinctly and quickly is to be avoided. A poor man when he is

reading his newspaper in the morning between the appeals of his stomach for coffee and eggs and his wife for money, will not sit down and read a long-winded advertisement, but if you can get some short, sharp phrase which will impress itself on his mind he will think about it. Then the question comes up of a series of articles in advertising and of starting out with a definite plan for instilling a definite number of ideas, and then following them up one at a time in a straight, connected series. In regard to the putting out of the two hundred-candle power Tungstens, I may say we have been experimenting during the last year by putting out five hundred-candle power or six hundred-watt Tungstens and have had very good results. I think when things settle down we can get a dependable life of about sixteen or seventeen hundred hours out of the six hundred-watt lamp.

In regard to signs, a great many companies, particularly on the other side of the line, have tried owning and maintaining signs, and practically all of them have given it up in favor of some method as outlined by Mr. Kelly, whereby one of the big sign Companies handles the work, and you practically limit yourself to supplying them with covers and occasionally helping in the maintenance of the signs. Personally, however, I think it is better to leave all of that entirely to the sign Company and not divide the responsibility for maintenance.

Mr. MacLachlan: I think we all recognize the value of Mr. Kelly's paper, but as it is a very late hour I will just touch on two points. Under "Electric Power," Mr. Kelly speaks of getting in touch with the Board of Trade of the town. I think that is a very valuable suggestion, especially when it is remembered than in the small towns the manager is also the "new business" man, and I think this Association would do well to see that some representatives from the towns appear at the Ontario Associated Boards of Trade at their Convention, usually held during February. I happened to be at the last Convention as the representative of a town, and a great number of points were brought up there which could be advantageously used to advertise the electrical industry. As to signs, I might say we have had some experience in that line, and I would advise very, very strongly against the Company owning signs and entering into long contracts, because a man, after seeing the same sign for a year or two years, gets thoroughly tired of it, and wants something new. Contracts range usually from three to five years, and it is a very bad proposition after you had had them up for a year or so.

President Dion: I may say that right from the beginning of the agitation for sign rental propositions I have been against it. At that time I seemed to be behind the times, but I am glad to see that most of the companies who went into it have come around to the view that I at first held. As regards the want of proper appreciation on the part of the generating end of the business in regard to the difficulties of the selling end, when the service is not what it might be, or when interruptions occur, I might say that the selling department in probably every company is suffering from this, because no matter how conscientious or

honest a man in the producing end may be he cannot appreciate the position fully because he does not come in contact with the public. You must do so to fully realize it, and I think it is an argument in favor of what many companies are doing and what we here are trying to do, (although we have not done very much yet) towards the getting together of the heads of the departments in some sort of intercourse and discussion so that they may exchange experiences in such a way as to be made to realize each other's troubles. When you get that condition, you will find the superintendent at the generating station trying to help out the man who is selling goods, because he knows and appreciates what he is up against.

I think all companies realize the benefit of advertising, but the question is, what is the best form of advertising. It is not so very many years since many companies did not advertise in any shape or manner. In that connection I am reminded of a little story that I heard the other day which may possibly be new to you. It is the case of a general store-keeper in a small country town, where perhaps he is the only store-keeper, and a commercial traveller comes to sell him some goods and finds the store-keeper indisposed to talk business, and instead the store-keeper asks the traveller to sit down to have a game of checkers. They sit down, and after a time a customer comes in and looks around the store, walks around and makes a noise and tries to attract the attention of somebody, but the merchant does not take his eyes off the checkers. Finally the commercial traveller says to him that there is a man in the store who wants to buy something, but the merchant says: "Hush, don't say a word, and he may go out again." (Laughter.)

Mr. Hornby: May I ask Mr. Kelly if he has tried the prepayment meters? In certain cases you can generally get a man to pay an additional sum on the rate per kilowatt-hour in part payment of the installation. You might fit up a small sign and charge him so much a kilowatt-hour until it is paid for.

Mr. Kelly: No, in Hamilton we have not had any experience with prepayment meters. I think in Ottawa they have had considerable experience, and since Mr. Pratt and myself came here we have discussed the matter with different members of the Ottawa Company with the possible object of using them in Hamilton at a rate that would cover the increased investment in that type of meter.

Regarding the electric sign proposition, I may say, referring to Mr. MacLachlan's point, and also Mr. Kemble's, that we had some little experience with a sign proposition where we owned the signs and maintained them, and I was personally very glad when an opportunity offered itself of interesting the Federal Sign people to secure some Canadian business. If you can get them to maintain the signs that is the ideal arrangement. We had competition in Hamilton in the electric sign game, and I put in a hurry-up call to the Federal people, and we rushed them over to Hamilton, and didn't take time to insist on their maintaing their

signs. They said they would not be in shape to maintain the signs, and therefore we started to do so, although I think when their business in Canada develops, as no doubt it will, that that will be the arrangement we will endeavor to make with them.

Mr. MacLachlan referred to getting in touch with the Boards of Trade. That is something I tried to impress on you very strongly in the paper. Mr. John Patterson, the Promoter of our Company, for many years was very closely allied with the Board of Trade and also with the City Hall people, and if a power industry was talked of as likely to come to Hamilton he simply made it his business to go to the place where that concern was and try to bring it to Hamilton. Lately, I have undertaken this work and have helped the City Hall officials in every way possible to secure industries.

I will not take up any more of your time now, except to say that I think it is very flattering to myself that no point has been brought up which I have not covered in this paper. I tried to cover every point I could think of, but there was one point which did escape me. It was brought to my attention, and I referred to it in a discussion yesterday. It is the point regarding the doing of educational work with your customers, both the commercial lighting customers and the manufacturers, along the lines of the proper lamps to use, etc. I think that is a very important point in a ''New Business'' department, and these remarks might be inserted at the end of this paper also.

The President: I want to say one word about signs: Unless you take an interest in the signs after you have sold them, and see that they are properly maintained they will not be maintained, and they will not be a credit to the Company which supplies the light, because the average merchant is not careful of his signs. In this city we have gone to the people who had signs in the spring, and we have said, ''You ought to paint your sign,'' or ''you ought to overhaul your sign.'' They would say ''Yes,'' of course, but they soon forgot all about it. What we did was to make a concrete proposition. We made arrangements with a painter, and we said to our customer, ''Your sign is not in good condition, and we will put it in good shape for $15'' (or $20, whatever it might be), and as a rule they jumped at the offer. They do not want to be bothered hunting around for a painter, but they are very glad to pay for the cost of it and be done with it. Mr. Kelly has certainly earned the thanks of this Association for giving us such a valuable contribution as his paper.

Mr. Marshall: Mr. Kelly, and Mr. Kemble particularly, made a remark about the generating man not appreciating the troubles of the sales department, and I could hardly let that go, as I happen to be a generating man. I will tell you a story of something that occurred in Toronto. This is a true story. We had occasion to shut down for a few minutes one Saturday afternoon, and a friend of mine happened to be sitting in a street car, and when the power went off one fellow said, ''Well, it is a funny thing that every time there is a thunderstorm the

power goes off, and it is a funnier thing still that it stays off for ten minutes; why, all they have to do is to put a fuse in and I could do that in a minute myself.'' I suggest this to show that there is still some educational work for the sales department to do.

The President: If any member would like afterwards to contribute to the discussions he may do so by writing to the Secretary and their contribution will be printed in the proceedings.

I may say also that if any of you would like to see the instruments and standards of all kinds in Mr. Higman's laboratory he will be very pleased to show them to you.

The Convention then adjourned till 2.30 o'clock.

AFTERNOON SESSION.

At 2.30 p.m. the President called the meeting to order, and said that the first item was the discussion of Mr. Stannard's address, which had been crowded out in the morning session.

One thing Mr. Stannard told us, which was borne out by the pictures which we saw, was that in England, where these pictures were taken, they seemingly paid very little attention to water in the conduits. Apparently they lay the conduits without any sealing of the joints. Apparently, they depend absolutely on the lead covering of the cables for protection. In American practice we try to keep the water out as much as possible, and go to considerable expense in order to do that. My idea was that trouble with electrolysis was the main reason why water was so carefully kept out, but he seems to think that it does not increase the danger very much.

Mr. O'Donnell: In the case of conduits for services I would like to know how the Companies arrange the different services from the conduits to the houses? Do they allow a service for each property or building as it were, and in that case should they hold a contract with the occupant of the premises? How would they get over the difficulty of these people changing companies or securing power from another company than those already in the conduit?

The President: That is a difficult problem. We are up against that problem here in this city. It is the idea here to make a manhole with two compartments and openings. It is a duplication of the whole thing. Each company must have access to all premises. The matter of contracts is one we simply have to make the best of; in most cases they are short contracts. The question is whether when you are going into this you should insist on getting a long contract or stay out. That is a matter of policy. The plans for Sparks Street in Ottawa will be very interesting because they show a duplicate system like this worked out in detail.

The next item is a paper by Mr. D. H. Ross of the Wagner Electric Manufacturing Company, on ''Power Factor, Its Influence and Effect.''

Mr. Ross: Before reading this paper I want to make an apology. We intended having a practical demonstration, but owing to the failure of the Railway Company to deliver the apparatus we are obliged to do without that part of it. I am sorry, as I am sure it would have been most interesting to you. This paper is not a study of power factor, but merely suggestions along certain lines.

POWER FACTOR, ITS INFLUENCE AND VALUE

D. H. Ross

Considerable time has been devoted to the study of load factor and its importance and the improvements this study has brought about have been very beneficial to Central Stations. But, little attention has been paid to the importance of high power factor and the necessity of including it as a basis of rates which will be fair not only to the operating company, but to the many classes of consumers as well.

The recent invention, however, of unity power factor motors has turned the attention of the operating companies to the possibilities of saving in cost of service, reduction in over-head charges, etc., to be derived by improving the power factor of their systems. A careful analysis of this subject by the engineering or cost departments of a company will convince the management of the necessity of constant improvement in this respect.

Consider that to supply a given kilowatt load at a low power factor involves:

(1) Unnecessarily large, hence, expensive generating machines, which are rated according to their current capacity.

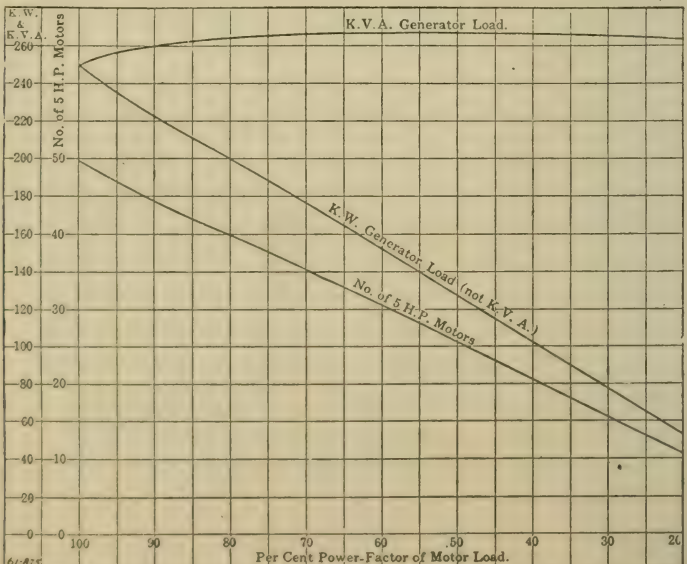


Fig. 1—Effect of Power Factor on Generator Capacity

(2) Similar expense in generating station, transforming and switching equipment.

(3) Large increase of transmission line, copper cost and distributing transformers.

(4) Increased core loss in transformers.

(5) Poor regulation of generators on low power factor.

(6) Underloaded prime movers, hence unnecessary capacity and decreased efficiency in their operation at low loads.

(7) Increased maintenance charges due to size and, in many cases, number of units of transformers, switch gear and transmission.

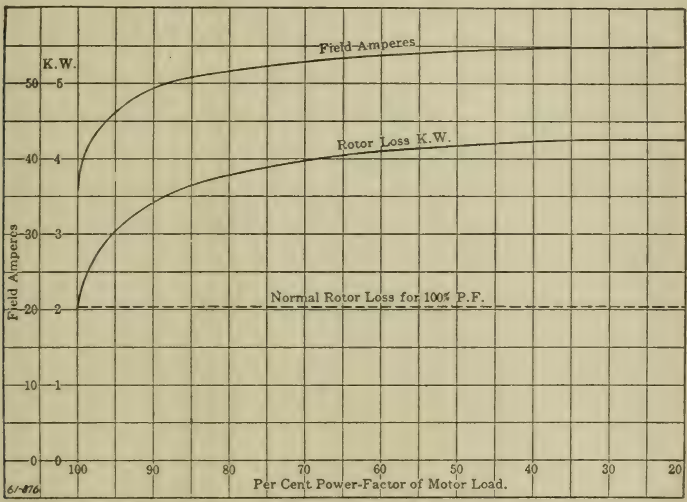


Fig. 2—Effect of Power Factor on Field Current and Rotor Loss.

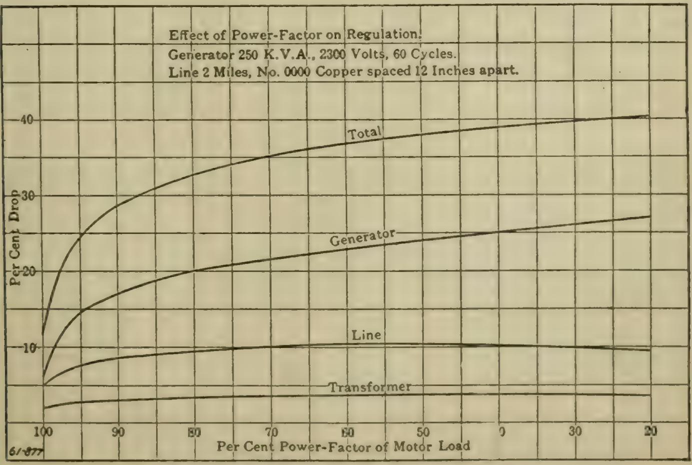


Fig. 3—Effect of Power Factor on Regulation.

The actual reduction in generator capacity as the power factor is reduced is shown in Figure 1. The lower curve shows the number of 5 H.P. motors which may be operated from a generator of 250 K.V.A. capacity at the different power factors. You will note that at 100% power factor the generator will drive 50 five H.P. motors, but at 50% power factor 25 motors only may be carried on the generator and transmission system. Note also that the generator load has increased from 250 to 270 K.V.A., due to the effect of poorer regulation at low power factor.

Referring to Figure 2 you will find that not only does the actual productive load to be carried decrease with low power factor, but in itself causes a decrease in efficiency of the generating station, as the

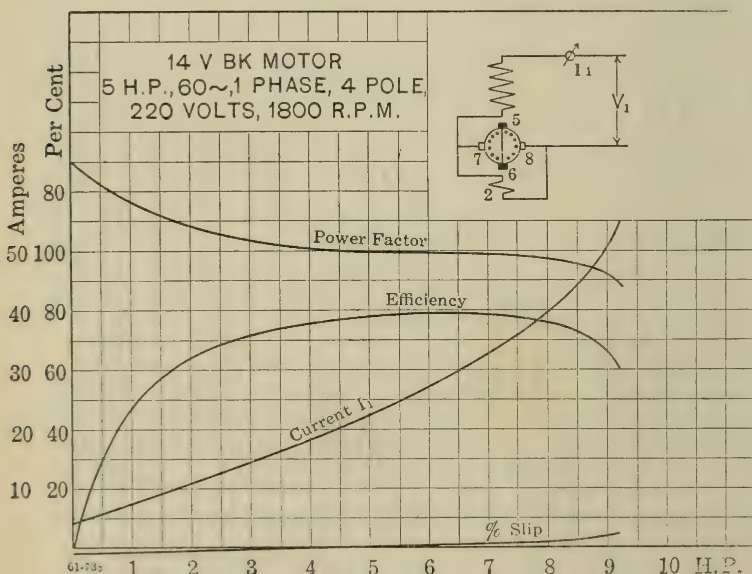


Fig 4.—Type B K Wagner Motor Normal Running Curves.

field loss is greater owing to the increased excitation, and the exciter sets are either overloaded or larger than is necessary, besides adding to the total loss.

Figure 3 clearly shows the serious effect of power factor on the regulation, and it is interesting to note that while the slightest increase in power factor is highly desirable, it becomes increasingly important as unity is approached.

From these considerations it is evident that power factor and costs of service are very intimately related, the cost depending almost proportionately one upon the other in a water power development and also in a steam plant, except for the extra cost of coal. Should not, therefore, all rate schedules contain a power factor clause which would

require the customer with the low power factor to pay for the increased losses and investments as previously listed? The consumer when he finds it to his advantage will install high power factor apparatus, and will pay an equitable amount for the power he receives. This state of affairs has been made possible by the production of a unity power factor motor.

This motor, which has been recently placed on the market by a well known manufacturing firm, is unique and marks a radical step forward in the design of single phase motors.

Note Figure 4, showing the normal running curves of the motor. The power factor is most interesting. You will note that running idle, the motor draws a leading current of 30%, which falls off rapidly as the load comes on, and is practically unity from half load to load and a

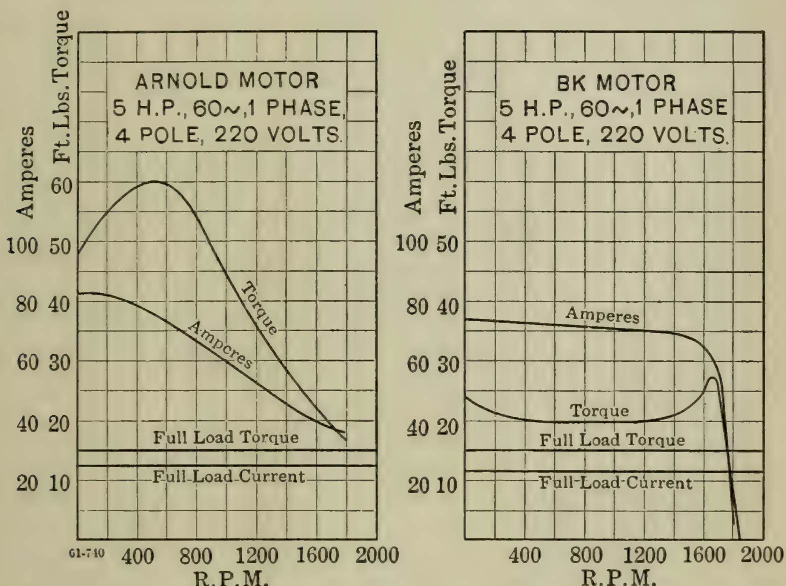


Fig 5—Comparison of Torque Characteristic of Arnold and Unity Power Factor Motors

half. In cases where it is desired, this motor can be connected over compensated, i.e., it will give a leading current of 5% to 10% at full load, and 40% to 50% running idle. Note also that the slip is practically negligible, being about 1½% at full load.

Figure 5 shows the comparison of speed torque curves of the Arnold and Unity power factor motors. It is interesting to note that while the torque at the instant of starting is not as large as is obtained in the Arnold motor, it is better sustained, and will bring up to speed any load it will start, which the Arnold type motor will not do, owing to the torque falling off rapidly as the speed increases. The new motor may at first sight appear to be somewhat complicated, but in reality

it is very simple mechanically and electrically. This motor is not radically different in operation from the repulsion type motor, i.e., it is started by simply throwing in a two-pole single-throw line switch, and the motor automatically takes care of the rest, giving the speed torque results shown.

Many of the Power Companies now recognize that single-phase distribution is the most economical for the smaller customers, and make it a rule that all installations of less than 7½ H.P. will be single-phase. Accepting this as correct from an economical and engineering standpoint, the importance of these unity power factor motors will be inestimable as a means not only of saving to the Central Station in installation, maintenance, metering, etc., over a polyphase installation, but maintaining a system of practically unity power factor.

This paper is not attempted as a treatise on this subject, but rather as a rough outline which may serve to promote valuable discussion among the members interested in Central Station economies.

Mr. Mudge: I think most central station men now appreciate the importance of keeping up the power factor of their systems, and any device which has the effect of bringing up the power factor I think should be very carefully investigated, as it, of course, increases the capacity of generators and transformers and lines, as well as making an improvement in the voltage regulation of the system. The cost of getting the improvement of power factor is an important element, and I would like to ask Mr. Ross about what percentage approximately does the cost of this power factor motor exceed the cost of the polyphase motor.

Mr. Hood: The question of power factor is one that cannot have too much consideration, and I am very glad to hear about the bringing out of a practical motor, which will bring up a higher power factor. We hardly realize, I think, until we get down to figures just how much money there is tied up between equipment and lines. In the induction motor load it is a question whether the average system is doing much better than sixty per cent. power factor, and if we could bring it up to 100 just think of the amount of apparatus which would be realized and how much better rates could be given to the power customer. The point of using a single-phase power supply for small motors is another very important question. It certainly simplifies our distribution considerably if we can stick to the single phase for the small outside power demands. The principal objection now of course to the single-phase supply is on account of the low power factor. If we put it on a secondary down comes the whole load, but with a motor of this kind it wouldn't disturb the regulation.

Mr. Kemble: Mr. Chairman, there are several questions I would like to ask Mr. Ross. The question of cost is most important, and when it comes to placing apparatus of this kind on the lines, as the customers

in many cases can see nothing but the question of cost of apparatus, they do not want to pay any increased cost. Then, do I understand Mr. Ross to say that motors of seven and a half-horse power do not require starting apparatus of any kind, but can simply be thrown on with a line switch? Then, I would like to ask in Figure 5 where the BK. Motor curve is given, what the normal is. There is a big hump through the torque curve and I was wondering whether the top of that curve was supposed to come at the full load point. Then, what is the possibility of getting a motor of this type at a reasonable price, that is to say, a price that would enable our customers to take hold of it. The fact that this motor has been produced as a commercial proposition starts a train of thought that, possibly, with the development of lines and the decreasing rates it might be possible by combined action or agreement among the companies to consider the power factor as a vital element in the forming of the rates. I am speaking purely speculatively, but taking into consideration the fact that this motor is in existence, with the rapid development we have had in electrical apparatus it would show we had better begin to speculate now in order to be able to handle the power factor question when it develops and whether it would not be desirable to have a form of K.V.A. meter—in other words, an integrating watt meter, which was not corrected for power factor, but which registered the actual K.V.A. and which would automatically fine a customer who had low power factor apparatus on his lines. Of course, that would be the ideally simple thing to do from the point of view of the commercial department, and I fancy also the meter department; besides it would secure automatically and without friction a steady pressure on the customer to instal nothing but the very highest power factor apparatus. With the development of the appliance industry, (and by appliance I refer not only to flatirons, toasters and things of that kind, but to vacuum cleaners and all kinds of small motors for driving household apparatus), and also with the tendency of the little shops to go out in the suburbs where they require anywhere from one to ten or fifteen horse power, it becomes a pretty serious problem in the extending of three phase lines to carry that power, as the units are small and pretty widely distributed, and in addition you often have to carry along a lighting system with it.

Now, with the four-wire local system that Mr. Hood brought out in his paper yesterday the possibilities of delivering small amounts of power with a motor of this type are intensely attractive to the commercial department. With that grounded system all you have to do is run one wire and attach it to the water pipe. I feel that the fullest information which Mr. Ross could give us in this matter, and also any information he could give us as to experiments which the maker of this motor has made on the larger sizes, would be extremely interesting and would enable us to be getting ready for the time which I feel sure will come in the comparatively near future when the power factor will be an assessed element in electric lighting.

The President: The Company with which I am connected makes it a rule that all motors of less than five-horse power shall be single-phase. Exception is made to that rule on business streets where the two-phase are available. The idea is that most of these small motors are liable to be demanded in all sorts of places which are not industrial districts or business districts, and it is difficult to supply them with anything but single-phase. This rule has been maintained pretty well by our competitors. Of course, the customer does not know anything about the power factor, but he objects to the increased price of a single-phase motor of the particular kind which costs still more, then it will be still more difficult to get him to buy it, unless by agreeing with your competitors, if you have any, to maintain this rule absolutely. Then you could force them to do it.

Now, our contracts contain a clause which says a horse power shall be seven hundred and forty-six volt amperes multiplied by so much per cent. so that we are actually being paid for the power factor which we think we ought to get, and if the power factor is lower the customer, of course, is losing. That is a condition in the contract, and therefore we can enforce it, that is, as far as the load is concerned. We have many motors on flat rates. Where a motor is on a meter it is not a straight meter rate, but a combination rate, partly flat and partly meter, so that while we are paid for the meter's registration on the basis of the actual watts we are paid for the readiness to serve on the basis of the watts multiplied by whatever power factor we wish to make; in that way we get a little for the low power factor. That is a very important thing, but it is one of the most difficult things I know of to get at in order to make a fair charge.

Mr. Kemble: I would like to ask Mr. Dion if he can give us any information as to how he establishes that—if he takes a series of measurements or how he does it, because we have one power customer on our lines who has a power factor clause in his contract, and finding out what that power factor is and satisfying the customer is a nuisance.

The President: I may say the power factor is absolutely arbitrary. It is made high enough to cover every possible case, and when it is applied to small motors it does not matter very much. If you were dealing with very large units, naturally the customer, if he was advised by a competent engineer, would dispute that clause, and probably he would not agree to it, but when you are dealing with small units a few per cent. higher or lower in the power factor does not matter very much. Of course, I recognize the fact that we could not enforce this arbitrary fixed power factor clause for large units.

Mr. Ross: In reference to Mr. Mudge's question as to the comparative cost of polyphase and single-phase motors, it is rather a difficult question to answer. You all know that single-phase motors are considerably more expensive than polyphase, and as the single-phase motor increases in size the difference increases, and there is no doubt that this increased cost of the motor has been detrimental to the central stations

in putting single-phase motors on their circuits. This has been overcome to a certain extent by several of the companies putting in the hands of their power solicitors prices of single-phase motors and instructing them to close up all the business at the time with the customers. The customer does not then get in touch with a whole lot of manufacturers who are not using single-phase motors. The cost of a one-horse power single-phase motor, I think, is about fifty per cent. over a polyphase, but up around five-horse power it is more than double the cost. This new type is about fifty per cent. more than the old type of motor made by the same company. As the prices on the old single-phase motors were not so high that they were prohibitive at all, so the new 100 per cent. power factor motors should do very well in regard to the cost or price.

With regard to Mr. Kemble's question, I may say that I think Mr. Kemble has certainly made a very fine comment on this matter. He asked about the seven and a half-horse power motors. I might say with regard to these single-phase motors that they all start up with practically the same percentage of starting current. If you refer to the diagram on Figure 5 you will note that the starting current of this new motor is approximately three times the full load current. Now, on a squirrel cage motor you will find, I think, at least three times the full load current there, or around there somewhere. Moreover, your line disturbance would not be any more than it is in a twenty-five or fifty-horse power motor than it would be on a fifty per cent. polyphase motor. With regard to the big peak that Mr. Kemble speaks of in the same figure, I would say that that is the pull out torque of the combined squirrel cage winding and the small compensating winding or repulsion type winding that is on the rotor of this motor. The slip is practically nothing, as you will notice, and the synchronized speed of that would be 1,800 revolutions, so that you would work your full load torque along that line and follow it out, which would about give you your speed reduction. Mr. Kemble's proposition regarding a K.V.A. meter is certainly very fine indeed. Several of the superintendents of the different power companies have already talked of some sort of meter as that, and I believe in the States they are going ahead and making arrangements, and in certain districts they are selling all their power on a K.V.A. basis, doing away with all power factor clauses which are a bugaboo to the ordinary customer and a source of all sorts of trouble between them and the central stations.

With regard to the experiments that have been made on the larger sized motors there is no manufacturing difficulty in producing these motors up to say fifty or seventy-five-horse power at the higher speeds, but I would call your attention to the fact that the unit power factor meter is not so absolutely necessary in the larger sizes as it is in the smaller sizes. A motor of fifty-horse power of fairly high speed and a polyphase motor will run up from 85 to 93 or 94 per cent. power factor, and consequently does not require the correction that the five-horse power or the three, or two, or one, or one-half-horse power, which run anywhere from

twenty-five, and possibly in some cases, seventy-five per cent., depending on the load they are operating on; so I think it will be some time before the larger-sized power factors are developed.

The President: Was there not a paper read at the National Electric Light Association meeting in New York last summer on the construction of the motors?

Mr. Ross: Yes, those of you who have the minutes of the report of the National Electric Light Association will find a paper which gives it more fully even than the paper which I mentioned, and also gives you some idea of its reliability.

The President: I am sure we are all obliged to Mr. Ross for preparing this paper, and we regret that the apparatus was not delivered, so that he might have given us a practical demonstration. I feel interested in the single-phase motor because I believe we will yet do a great deal more with it than we have been doing in the past.

The next item of business is the report of the Committee on Rates and Forms of Contract which is to be given by Mr. Parker H. Kemble, the Chairman of the Committee.

Mr. Kemble: I want to ask your particular attention to the footnote at the bottom of the first page of the printed report. The compilation of all the rates of the various companies will take up somewhere around fifty pages, and, as this tabulation work is extremely slow for the printers, your Secretary decided, and very wisely, I think, that rather than block up the work on the other material for the Convention, this report should go in with a sample page of each type of classification, the full classification or schedule to be printed in the proceedings.

REPORT OF COMMITTEE ON RATES AND FORMS OF CONTRACT

This being the first year of the existence of a committee on ''Rates and Forms of Contract,'' it has been considered advisable to devote such time as was available to the gathering of data, in order that next year's Committee might have some information on which to work. This year, therefore, the Committee's report consists of a compilation of the various rates at present in force in Canada.

In the effort to make the information contained in the classification of rates more available to those in search of information, particularly to those on whom rests the responsibility for making changes in existing or establishing new rates, a departure has been made from the usual method of classification. Instead of all rates of each Company being placed under the heading of that Company, the list has been divided into three classes:

Rates based on the demand principle.
Flat Rates.
Straight Meter Rates.

Under each of these classes the Companies will be found arranged alphabetically by cities or towns. Thus, anyone interested in developing a flat rate will find all of the flat rates classed together, similarly the demand and the meter rates. As the Companies are indexed by towns alphabetically, it has not been considered necessary to have a separate index or cross-index.

During the constant handling of the various contract forms while arranging the classification of rates, one thing has been particularly noticeable, and that is, that there would seem to be nothing to prevent the adoption of a standard set of terms and conditions. These terms and conditions, as embodied in practically all of the contract forms which the Committee has received, have only to deal with the right of access to the Company's property, the preservation of the same by due care on the part of the customer, and clauses designed to insure that there may be no question as to the party in whom the right of installed material rests at the expiration of the contract between the Company and the consumer.

Besides these property considerations, a clause providing for immunity from damage liability due to reasons of failure to supply, or due to the presence of the electric current on the premises, and clauses to allow of discontinuance for non-payment of bills, cover the requirements of the general terms and conditions which are made part of the various contracts.

It would seem advisable, therefore, in view of the general tendency on the part of the Canadian businessman to "refer this to his solicitor," to have as much of the contract as possible, outside of the actual rates and special conditions required by special service, standardized, so that this cause for delay and friction may be obviated.

The adoption of a standard set of terms and conditions would be the first step, and a long step, towards the adoption of a standard form of contract which all Electric Light Companies could use, as, after all, the only difference of any account between one contract for electric service and another is the paragraph or paragraphs governing the rates and their method of administration.

That this is not as difficult a problem as it would seem at first sight is shown by the fact that one of the large Canadian companies has been operating for the last year under a standard form of contract identical in wording for all classes of service except for the small paragraph containing the actual specifications of the rate to be charged. The advantages of such a standard form are so many and so obvious, not only in view of the competition between companies, but the entrance of municipalities into the field, as not to warrant space being taken here for their enumeration.

Your Committee, therefore, have to recommend for the work of next year's Committee, as follows:

First—That the list of rates be revised and kept up to date.

Second—That drafts of a standard form of contract be made, submitted to legal authority and embodied in next year's report for discussion by the members of the Association.

Third—That the question of uniform standards in rates be considered, by uniform standards being meant peak load periods, methods of assessing demand, questions of allowances for lamp discount, etc.

In the appendix are included some tables which it is hoped will be found useful by those who have occasion to compare the various forms of rates.

Parker H. Kemble, Chairman.
J. H. Larmonth.
A. L. Mudge.
Committee on Rates and Forms of Contract.

Proposed Terms and Conditions.

TERMS AND CONDITIONS.

Referred to in, and Made a Part of, this Agreement.

1. The Customer consents that during the term of this agreement, the Company shall, through its proper agents and employees, at all reasonable hours, have access to the premises of the Customer, for the purpose of inspecting, adjusting, repairing and otherwise caring for its service connections, meters and other property which may be on the said premises, and on the termination of the contract, shall be permitted to remove the same from said premises, and the Customer further agrees that no one who is not an Agent of the Company or otherwise lawfully entitled to do so shall be permitted to remove, inspect or tamper with the above mentioned appliances or property of the Company.

2. Meters and all other appliances of the Company in said premises shall be in the care and at the risk of the Consumer, and if destroyed or damaged by any cause other than ordinary wear and tear or act of the Company, the value of such meters and appliances, or the cost of repairing and replacing the same shall be paid by the Consumer.

3. It is hereby agreed that the Company shall have the right to discontinue, cut off and remove its service and all other material belonging to it from the said premises as soon and as often as default shall be made by said Customer in payment of bills, or in performance by said Customer of the terms of this agreement.

4. The Company will not be liable for damages by reason of failure to supply electric energy where the failure is caused from natural causes or accidents in any way, nor shall the Company be liable in any event or circumstance for damages to person or property arising, accruing or resulting from the use of current.

The President: Gentlemen, this is what I call good Committee work, a Committee going into a matter of such practical and vital importance to us and treating it in this way so as to bring results that are immediately useful. This Committee has at the same time laid down a foundation for a system which, if carried out, will be very valuable indeed. I knew when I asked Mr. Kemble to handle this subject that he would do it justice. I have been agitating for some years for statistics. We had an old Statistical Committee and they did not obtain the results which they expected; perhaps they attempted too much. We are certainly interested in knowing what other people are doing as to rates and the manner in which they apply those rates, and when our rates are criticized or attacked it gives us something to fall back on, and at the same time we get a lot of new ideas, and possibly in the course of time we may, with the Hydro-Electric Commission of this Province, standardize our practice. I do not know that any standardization would be of much use unless the Commission standardized it with us, but it is not impossible, I suppose, to get the Hydro to standardize on a system of rates and the manner of applying them. In this city they are standardized to some extent with them, and that is good work.

Mr. Pack: I think it is somewhat unfortunate that the report of this Committee had necessarily to be presented at this late date, because it is a matter of vital importance in the sale of current. In the past so many technical conditions have entered into the question of rates and contracts that the average layman who is taking current from a company does not understand what it all means, and he gets the impression that the Company is trying to put something over on him. Now, if we could not get rates in exactly standard form, we could at least get terms and conditions of a contract absolutely standardized. I suppose that as an Association we are not ready to put ourselves on record as accepting the proposed form as the standard law; I think the recommendation made by the Committee is an excellent one, viz., that the work of the incoming Committee for the coming year should be to prepare a set of terms and conditions, which, after receiving some legal sanction, might be accepted by the Association, and sent abroad with the approval of the Association after next year's Convention. In order to do this, however, I think it will be necessary to communicate with those in charge of the companies in Canada and get their approval to the principles involved. In this connection I might call the attention of the members present to the very excellent report of the Rates Committee of the National Electric Light Association, which is now being published. They, too, feel the necessity that we are now feeling of having some standard form of rates and standard form of contracts. They think it will be conducive to a better feeling on the part of our customers and very helpful to the business as a whole. I should like to express my personal approval of the work of this Committee. I do not think we can speak in too high terms of the very excellent report presented.

I am very pleased to move that the Committee be continued.

Mr. McDunnough: I have much pleasure in seconding that motion.

Mr. Bird: I think this Committee should be continued. I think the nearer we get to standard rates and standard contracts the better position we will be in to show where we stand when we have to go before the regulating Commissions, which are almost bound to come in the future.

The President: If we could fall back on some authority and say this is the standard it would be a source of great strength.

Mr. Bird: It seems to me, on account of the different Provincial laws that would affect the standardization of rates you would have to refer the matter to a solicitor, especially the larger companies who have been up against these things, to determine if it is possible to have a standard rate for the whole of Canada. It would be easy to have one for any one Province, but it might not be so easy for the whole Dominion.

Mr. McDunnough: It seems to me that the Dominion Act is the fundamental foundation on which we have to go, and the public service Commissions could not go behind that.

Mr. Bird: It would be a question for the lawyers to fight out.

Mr. Pack: I do not think it makes very much difference what terms and conditions you make in a contract. If it is against the law of the land it has no effect in any case, and I think a standard form of contract containing general terms and conditions could be drawn up which would be satisfactory in every Province. Of course, I think it would be necessary to submit it to some legal authority in each Province, but I do not think that a customer can legally sign away his right to collect damages, nor can a Company refuse to supply current if he will not sign a contract of that kind.

Mr. Kemble: In answering some of the remarks that were made, I wish to express my apreciation and the appreciation of the other members of the Committee for the extremely flattering reception the report has received, and also to state that we will endeavor to do as well in our next year's report. As regards what Mr. Bird has spoken of, the question of inter-Provincial uniformity, the idea of the Committee in submitting these proposed terms and conditions this year was not that this should be immediately and unanimously adopted for the whole of Canada, but as the work of the Committee for this year was entirely new and tentative, to provide something which would act as a basis on which to work. I had a brief talk with a lawyer of rather good standing in Toronto, and he assured me that the differences between the Provincial laws as affecting a contract for the supply of merchandise (which he claimed the electric service contract was), were very small, providing you did not attempt to put in penalty clauses. He said the greatest differences came in as to the way the different Provinces looked at the penalty clauses. This is what you might call an unofficial legal opinion, but I thought it might be of interest in view of the fact that some doubt was expressed as to the possibility of arranging a general broad contract.

The President: The next item is the report of the Committee on Uniform Accounting. Colonel Street is not able to be present, but he has handed in this report.

REPORT OF THE ACCOUNTING COMMITTEE, CANADIAN ELECTRICAL ASSOCIATION.

To the President, Officers, and Managing Committee, Canadian Electrical Association:—

Your Committee on Accounting beg to report as follows:—

At the Convention of 1911, held at Niagara Falls, Ont., the outgoing Committee on Accounting recommended that such Committee be continued, it being understood that the work of this Committee was to keep its eyes open for accounting matters that might be of value to the Association or to its individual members.

Your Committee, therefore, felt that for this year it would be wiser to watch the working of the new system of accounting by the companies that had adopted it. Unfortunately, as far as we can learn, very few have made the change. This is regrettable for various reasons. In the first place, it does not afford a channel for proper comparison of costs, etc., which we should have in Canada, and it is an indication that managers of electric light companies in Canada do not give sufficient attention to what they will soon realize is a very important branch of their business. With electric companies where there must necessarily be a large continued expenditure of capital, and where directors, as a rule, make a point of seeing that such expenditure is prudently made, it does seem strange that they are not exercising the same care in insisting that there shall be a minute and clear record of every dollar expended.

Your Committee, therefore, can only urge that companies, members of this Association, shall at once fall into line and change their bookkeeping systems to agree with the uniform system adopted by the National Association and by our own Association. The advantages are obvious.

It is to be noted that a number of Public Service Commissions of the United States have adopted the standard classification of the National Electric Light Association. The latest to do this was the Public Service Commission of Maryland, and we, therefore, feel that in Canada, in this age of municipal ownership, electric light companies should set an example that municipalities might follow.

Your Committee further recommends that all members of our Association interested in accounting should read the following papers submitted at the last Convention of the National Electric Light Association, held at Seattle, Wash., June 10th to 14th, 1912:—

Report of Committee on Uniform Accounting.

Regular Electric Light Accounting.

By H. M. Edwards.

Scientific Management of Accounting Departments.

By Franklin Heydeck.

General Filing Systems.

By R. H. Williams.

Progress Made in the Use of Tabulating Machines.

By Wm. Schmidt.

These papers contain a fund of valuable information, and should be in the possession of every office manager and accountant.

Class "A" members, will, of course, get these papers in the printed proceedings of the Association which are sent out in due course. Class "B" members can obtain these particular papers on accounting by simply applying for them through the Secretary of the National Electrical Light Association, 29 West 39th St., New York.

Your Committee further recommends that the Committee on Accounting be continued and that at the Convention in 1913 accounting sessions be held, also that companies be urged to send their accountants, or, at least, the chief accountant, to the next Convention, in order that they may take part in discussions at the accounting sessions.

All of which is respectfully submitted.

Mr. Pratt: Mr. President, with reference to the mention which was made as to the possibility of obtaining advance copies of the accounting papers, I had occasion to correspond with the Secretary of the National Electric Light Association in New York a few days before I left regarding some paper which I wished to obtain in advance of the bound volumes, and they told me that on payment of the sum of $2.50 they would be very pleased to send a complete set in pamphlet form of the papers given in the recent Convention to any member of the Association. These reports and papers in pamphlet form are in some ways more valuable than the bound volume, because the individual papers can be handed out to those who are specially interested.

The President: Of course, each Class A member gets one copy of each without charge.

It was moved by Mr. Webber and seconded by Mr. Bird that the report be adopted.

The President put the motion, which, on a vote being taken, was declared carried.

The President: The next item is the report of the Public Policy Committee.

Mr. Pack: I have the report here which Mr. Hawlsins has asked me to present. As this work is more or less of a confidential nature, a lengthy report cannot be given. I believe very valuable work may be done by the Public Policy Committee, and I would ask the members

to communicate with that Committee if they think at any time that the Committee can give them any help. Individual companies get into awkward situations sometimes and the experience or advice of someone else is desirable and very useful. The members who are present might pass this information along as the Public Policy Committee exists for this purpose, amongst other things, and is only too willing to render any help.

REPORT OF PUBLIC POLICY COMMITTEE.

To the Members of the Canadian Electrical Association:—

Gentlemen,—The Public Policy Committee was appointed by your President to consider and to take action upon matters pertaining to the welfare of the companies. It has had under consideration during the past year such subjects as Legislation Affecting the Companies, Employers' Liability Acts, Compulsory Undergrounding of Wires, etc., etc.

At the recent session of the Ontario Legislature, legislation seriously affecting the rights of the companies in Ontario was proposed, and your Committee took the necessary steps to have the Canadian Electrical Association represented by counsel, with the result that the legislation, as finally passed, was very much less inimical to the companies.

Your Committee wishes to point out that it is impossible to do good work for the companies in Canada unless these companies are sufficiently interested to become members of the Association and to keep in such close touch with the Secretary that he may be enabled to render help to individual companies from time to time as occasion may require.

The very nature of the work of the Public Policy Committee renders it impossible to submit a lengthy report, but, in conclusion, it might be pointed out that the Public Policy Committee of the National Electric Light Association consists of the most prominent men in the central station industry in the United States, and that the work of that Committee has had far-reaching results in benefitting the companies on the other side of the line.

It is our desire and aim to follow this good example and your Committee earnestly trusts that the companies in Canada will take advantage of the opportunities offered so that in future this branch of the Canadian Electrical Association may be of greater assistance to its member companies.

Respectfully submitted,

WM. W. HAWKINS,

Chairman.

The President: The next report is that of the Committee on Standardization of Line Construction. Mr. Black was the Chairman, but he is away, and therefore there is no written report. I can, however, tell you exactly what the report would have been. The Committee reported last year that the National Electric Light Association, having gone most thoroughly into the question, and having had a Committee of experts at work for three years, had brought out a handbook on Line Construction. This was not approved last year by the National Electric Light Association because of a point raised by one of the members as to what distance its lines, where transmission lines crossed their lines, should be. He claimed that it would interfere with some private agreements made with other companies, and so on. The matter has since been investigated and settled. That clause has been somewhat elaborated so as to remove the difficulty, and in that shape it is to be submitted to the Convention at Seattle. I have had no news from Seattle, and I do not know whether they adopted it or not, but I am satisfied they did, because that was the only objection. Now, Mr. Black's Committee's recommendation was that as soon as the National Electric Light Association should adopt it, we should adopt it, because it is the best thing we could possibly get on the subject. Whether we adopt it as an Association or not, it is good practice to follow. I think it might be a good thing if it was adopted by this Association because it would then become standard practice, and in case of any question arising as to the construction of lines in case of accident, you could have that argument that it was recognized or adopted by the Association. However, in the absence of this handbook or report, we can hardly adopt it, I suppose. That is the only thing the Committee could report, and what they would report, because I know Mr. Black's ideas on the subject.

Before closing there are three things to be done, namely, the making of Standing Committees, choosing of the place for the next meeting, and unfinished business.

Mr. Pack: In regard to the first two items, I move that they be left to the incoming Managing Committee.

Mr. Kemble: I second the motion.

The President put the motion, which, on a vote being taken, was declared carried.

The President read a telegram from the Mayor of Port Arthur inviting the Association to meet in that city in 1913. He also read a telegram from the President of the Michigan section of the N. E. L. A., then embarking on the steamer Majestic at Port Huron under the Canadian flag, sending greetings. It was left with the Secretary to compose and send appropriate replies.

Mr. Pack: If it is quite proper and fitting at this time, I should like to have the privilege of moving a resolution of thanks to the Local Committee, and to all those who have contributed to the success of this very enjoyable and successful meeting. The drafting of the resolution can be left till a later date.

Mr. Kemble: I take pleasure in seconding that, and also expressing the thanks of myself personally and as a member of the Convention, and also the thanks of Mrs. Kemble, for the way in which the personal element has been brought in by the local Committee in the way of taking care of the members and friends. It has been a charming personal way of looking after all the members of the Convention, so that it gives me added satisfaction in seconding the motion.

The President put the motion, which, on a vote being taken, was declared carried. (Applause).

At the suggestion of Mr. Pack, the audience arose and gave three cheers and a tiger for President Dion, expressing appreciation of the work he had done and the able way in which he had handled the Convention.

The President: I assure you this pleases me immensely, but you do not need to thank me. It pleases me, as it must please all the members of the Local Committee, to hear you say you have appreciated the things we have done to entertain you. As long as you are happy and have enjoyed it, we are satisfied—fully repaid.

I would like to say one word with reference to a fellow-worker who is not here—Colonel Street. He has not been able to attend a single meeting or hear a single paper because his work outside for us has kept him so busy. He has been a hard worker, and because he is not here to receive bouquets I wish to say a good word for him.

The members joined in a hearty round of applause for Colonel Street.

The Convention then closed, the members repairing to the baseball grounds to meet in the evening at the smoker.

APPENDIX

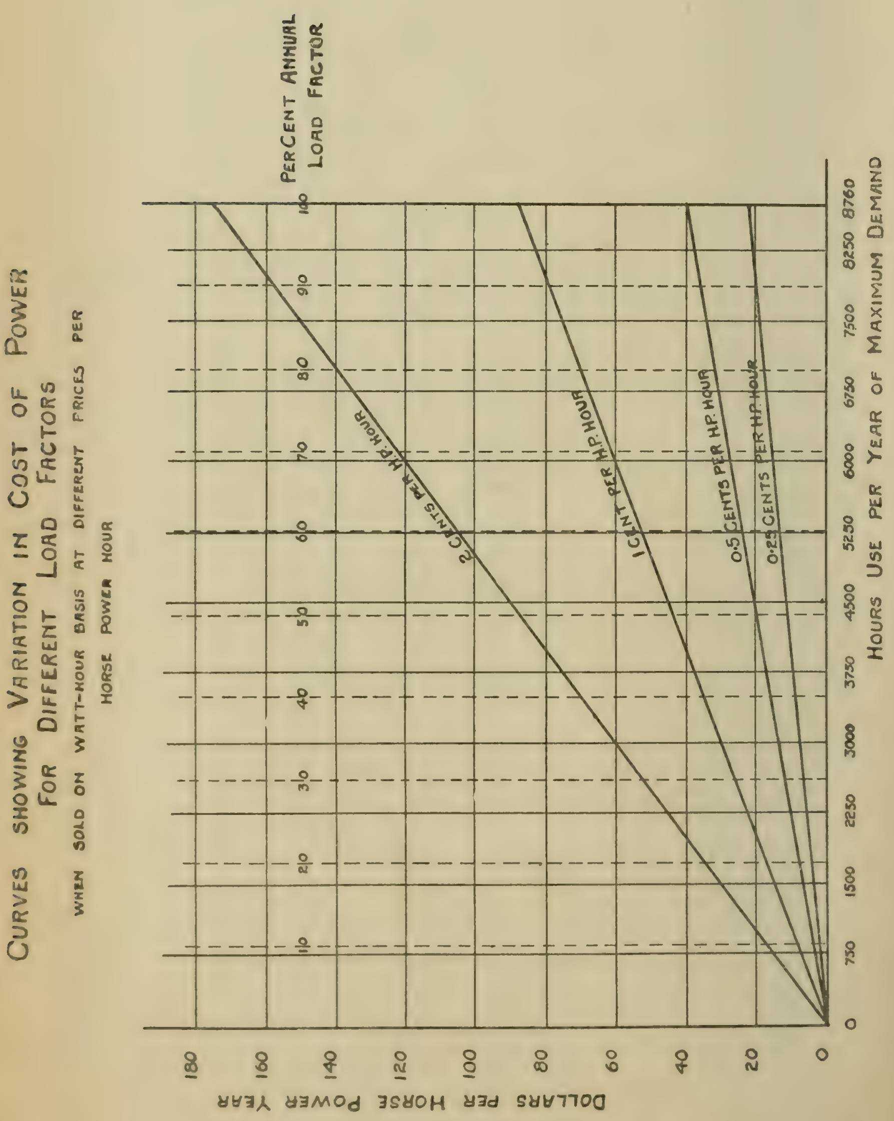
Containing Tables and Curves prepared by the Committee on Rates and Contracts.

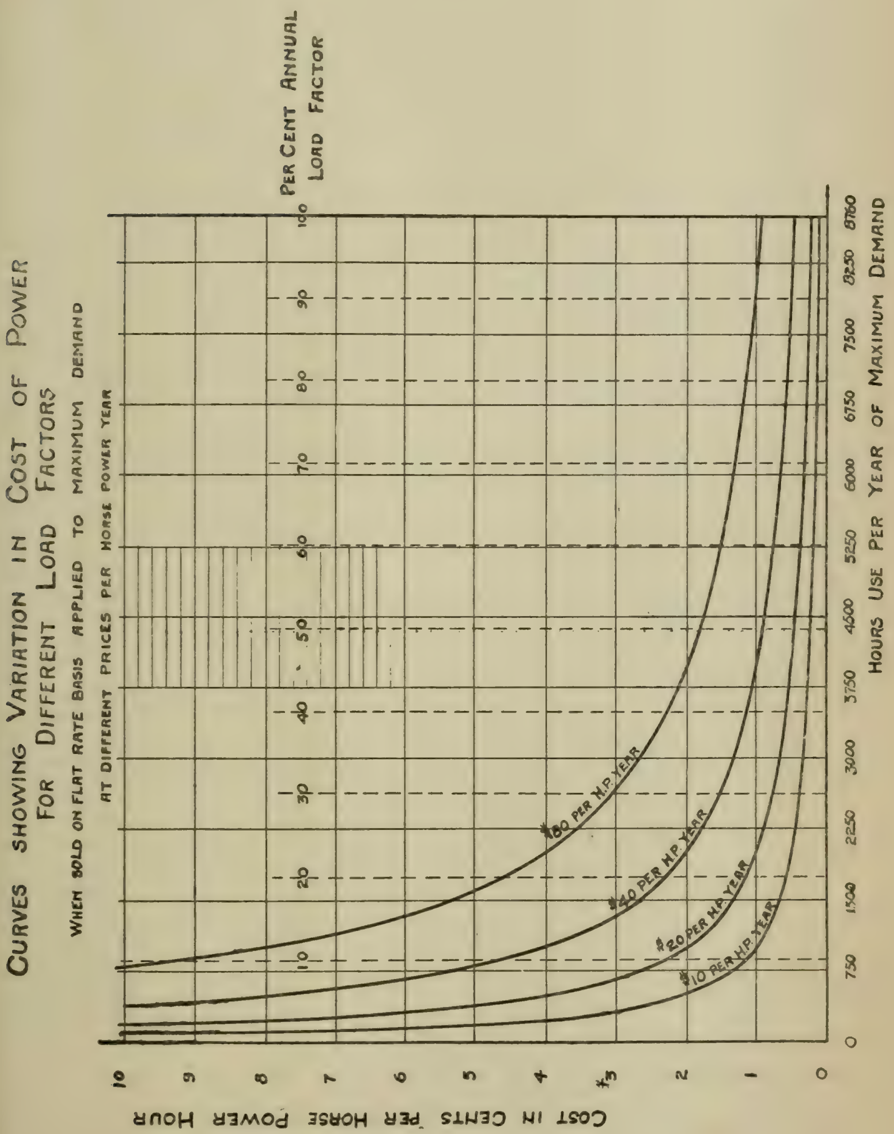
K.W.H. monthly consumption for one mechanical H.P. (delivered) for different motor efficiencies and load factors.

Load factor	100%	75%	50%	40%	30%	20%	10%
Hours per Month	730	548	365	292	219	146	73
Hours per Day	24	18	12	9.6	7.2	4.8	2.4
App. Hrs. per Day	24	18	12	10	7	5	2½
Motor Efficiency		K. W. Hours per Month					
100%	545	408	272	218	163	109	55
95	573	430	287	229	172	115	57
90	605	454	302	242	182	121	61
85	641	481	320	256	192	128	64
80	681	511	340	272	204	136	68
75	726	545	363	290	218	145	73
70	778	584	389	311	233	156	78
65	838	628	419	335	251	168	84
60	908	681	454	363	272	182	91
55	988	741	494	395	296	198	99
50	1089	817	545	436	327	218	109

K.W.H. Rates	EQUIVALENT K.W. YEAR RATES AT VARIOUS LOAD FACTORS						
Load Factor........	100%	75%	50%	40%	30%	20%	10%
Hours per Year.....	8760	6570	4380	3504	2628	1752	876
Hours per Month....	730	547½	365	292	219	146	73
Hours per Day......	24	18	12	9.6	7.2	4.8	2.4
App. Hours Daily...	24	18	12	10	7	5	2½
Rate per K.W.H.		Co	st per	K. W.	Year		
2.00...............	175.20	131.40	87.60	70.10	52.55	35.05	17.50
1.75...............	153.30	114.95	76.65	61.30	46.00	30.65	15.35
1.50...............	131.40	98.55	65.70	52.55	39.40	26.30	13.15
1.45...............	127.05	95.25	63.50	50.80	38.10	25.40	12.70
1.40...............	122.65	92.00	61.30	49.05	36.80	24.55	12.25
1.35...............	118.25	88.70	59.15	47.30	35.50	23.65	11.85
1.30...............	113.90	85.40	56.95	45.55	34.15	22.80	11.40
1.25...............	109.50	82.15	54.75	43.80	32.85	21.90	10.95
1.20...............	105.15	78.85	52.55	42.05	31.55	21.00	10.50
1.15...............	100.75	75.55	50.35	40.30	30.25	20.15	10.05
1.10...............	96.35	72.25	48.20	38.55	28.90	19.25	9.65
1.05...............	91.95	69.00	46.00	36.80	27.60	18.40	9.20
1.00...............	87.60	65.70	43.80	35.05	26.25	17.50	8.75
.95...............	83.20	62.40	41.60	33.30	24.95	16.65	8.35
.90...............	78.85	59.15	39.40	31.55	23.65	15.75	7.90
.85...............	74.45	55.85	37.25	29.80	22.35	14.90	7.45
.80...............	70.10	52.55	35.05	28.05	21.00	14.00	7.00
.75...............	65.70	49.25	32.85	26.30	19.70	13.15	6.55
.70...............	61.30	46.00	30.65	24.50	18.40	12.25	6.15
.60...............	52.55	39.40	26.25	21.00	15.75	10.50	5.25
.50...............	43.80	32.85	21.90	17.50	13.15	8.75	4.40
.40...............	35.05	26.30	17.50	14.00	10.50	7.00	3.50
.30...............	26.30	19.70	13.15	10.50	7.90	5.25	2.60
.25...............	21.90	16.40	10.95	8.75	6.55	4.40	2.20
.20...............	17.50	13.15	8.75	7.00	5.25	3.50	1.75
.10...............	8.75	6.55	4.40	3.50	2.60	1.75	.88

K.W.H. Rates	VALENT H.P. YEAR RATE AT EQUIVARIOUS LOAD FACTORS						
Load Factor........	100%	75%	50%	40%	30%	20%	10%
Hours per Year.....	8760	6570	4380	3504	2628	1752	876
Hours per Month....	730	547½	365	292	219	146	73
Hours per Day......	24	18	12	9.6	7.2	4.8	2.4
App. Hours Daily...	24	18	12	10.0	7	5	2½
Rate per K.W.H.			Cost p	er H.P.	Year		
2.00...............	130.70	98.00	65.35	52.25	39.20	26.15	13.10
1.75...............	114.35	85.80	57.20	45.75	34.30	22.90	11.45
1.50...............	98.00	73.50	49.00	39.20	29.40	19.60	9.80
1.45...............	94.75	71.10	47.40	37.90	28.45	18.95	9.50
1.40...............	91.50	68.60	45.75	36.60	27.45	18.30	9.15
1.35...............	88.20	66.05	44.10	35.30	26.50	17.65	8.85
1.30...............	84.95	63.75	42.50	34.00	25.50	17.00	8.50
1.25...............	81.70	61.30	40.85	32.70	24.50	16.35	8.15
1.20...............	78.40	58.80	39.20	31.35	23.55	15.70	7.85
1.15...............	75.15	56.35	37.60	30.05	22.55	15.05	7.50
1.10...............	71.90	53.90	35.95	28.75	21.55	14.35	7.20
1.05...............	68.60	51.45	34.30	27.45	20.60	13.70	6.85
1.00...............	65.35	49.00	32.70	26.15	19.60	13.05	6.55
.95...............	62.05	46.55	31.05	24.85	18.60	12.40	6.20
.90...............	58.80	44.10	29.40	23.50	17.65	11.75	5.85
.85...............	55.55	41.65	27.75	22.20	16.65	11.10	5.55
.80...............	52.25	39.25	26.15	20.90	15.70	10.45	5.20
.75...............	49.00	36.75	24.50	19.60	14.70	9.80	4.90
.70...............	45.75	34.30	22.85	18.30	13.70	9.15	4.55
.60...............	39.20	29.45	19.60	15.70	11.75	7.85	3.90
.50...............	32.65	24.55	16.35	13.05	9.80	6.50	3.25
.40...............	26.15	19.60	13.05	10.45	7.85	5.25	2.60
.30...............	19.60	14.70	9.80	7.85	5.90	3.95	1.95
.25...............	16.35	12.25	8.15	6.55	4.90	3.25	1.65
.20...............	13.05	9.80	6.55	5.20	3.90	2.60	1.30
.10...............	6.55	4.90	3.25	2.60	1.95	1.30	.65


CURVES SHOWING VARIATION IN COST OF POWER
FOR DIFFERENT LOAD FACTORS
WHEN SOLD ON WATT-HOUR BASIS AT DIFFERENT PRICES PER
HORSE POWER HOUR
PER CENT ANNUAL
LOAD FACTOR
10
20
30
40
50
60
70
80
90
100
2 CENTS PER H.P. HOUR
1 CENT PER H.P. HOUR
0.5 CENTS PER H.P. HOUR
0.25 CENTS PER H.P. HOUR
0
750
1500
2250
3000
3750
4500
5250
6000
6750
7500
8250
8760
HOURS USE PER YEAR OF MAXIMUM DEMAND
0
20
40
60
80
100
120
140
160
180
DOLLARS PER HORSE POWER YEAR


CURVES SHOWING VARIATION IN COST OF POWER
FOR DIFFERENT LOAD FACTORS
WHEN SOLD ON FLAT RATE BASIS APPLIED TO MAXIMUM DEMAND
AT DIFFERENT PRICES PER HORSE POWER YEAR
PER CENT ANNUAL LOAD FACTOR
10 20 30 40 50 60 70 80 90 100
$80 PER H.P. YEAR
$40 PER H.P. YEAR
$20 PER H.P. YEAR
$10 PER H.P. YEAR
0 750 1500 2250 3000 3750 4500 5250 6000 6750 7500 8250 8760
HOURS USE PER YEAR OF MAXIMUM DEMAND
0 1 2 3 4 5 6 7 8 9 10
COST IN CENTS PER HORSE POWER HOUR

Proceedings of the Twenty-Third Annual Convention

of the

Canadian Electrical Association

Held at Toronto, Ontario
June 25th, 26th, 27th
1913

Office of the Association
610 Confederation Life Building
Toronto, Ont.

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Canadian Electrical Association

Officers 1913-1914

President:
D. R. Street,
The Ottawa Electric Company, Ltd., Ottawa, Ont.

1st Vice-President:
A. L. Mudge,
The Electric Power Company, Ltd., Toronto, Ont.

2nd Vice-President:
D. H. McDougall,
The Toronto Electric Light Co., Ltd., Toronto, Ont.

3rd Vice-President:
Wills Maclachlan,
Trenton Electric and Water Co., Ltd., Toronto, Ont.

Honorary Secretary:
T. S. Young,
220 King St. W., Toronto, Ont.

Secretary-Treasurer:
J. H. Larmonth,
610 Confederation Life Bldg., Toronto, Ont.

Managing Committee:
W. G. Angus,
The Dominion Power and Transmission Co., Ltd., Hamilton, Ont
W. L. Bird,
Kaministiquia Power Co., Ltd., Fort William, Ont.
F. G. Clark,
The Toronto Electric Light Co., Toronto, Ont.
A. A. Dion,
Ottawa Electric Company, Ltd., Ottawa, Ont.
A. E. Dunlop,
Pembroke Electric Co., Ltd., Pembroke, Ont.
J. S. Gould,
Citizens' Electric Co., Ltd., Smith's Falls, Ont.
H. G. Matthews,
The Quebec Railway, Light and Power Co., Quebec, P.Q.
E. L. Milliken,
Cape Breton Electric Co., Ltd., Sydney, C.B.
R. S. McDunnough,
North Shore Power Co., Ltd., Three Rivers, Que.
L. W. Pratt,
The Dominion Power and Transmission Co., Ltd., Hamilton, Ont.
W. S. Robertson,
The Electric Power Co., Ltd., Toronto, Ont.
R. J. Smith,
Canadian Electric and Water Power Co., Ltd., Perth, Ont.
R. H. Sperling,
British Columbia Electric Ry. Co., Ltd., Vancouver, B.C.
R. M. Wilson,
The Montreal Light, Heat and Power Co., Montreal, Que.

Twenty-third Annual Convention of the Canadian Electrical Association

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MEETING HELD IN CHEMISTRY AND MINING BUILDING, COLLEGE STREET TORONTO, ONT.

Wednesday, June 25th, 1913.

THE PRESIDENT: Ladies and Gentlemen, the Opening Session of the Convention will now be called to order. The first proceeding is the reading of the Minutes of the last meeting. We would probably save time if some one would move that we take the Minutes as read.

D. H. MCDOUGALL, Toronto Electric Light: I move that we dispense with the reading of the Minutes and take them as read.

MR. MANSER: I second that. (Motion carried.)

THE PRESIDENT: The next order of business is the President's address. On behalf of the Association, it affords me a great deal of pleasure to welcome our ladies and friends of the Association. We are particularly glad to see our lady friends with us this time, and hope they will enjoy and take part in our discussion.

Looking at our field and how much we have to cover, even in one year, it is very difficult to decide where to start and how much to cover. It is very fortunate all our discussions are held down to a limited time, otherwise we would be kept busy for the full week and probably a good deal longer.

The Papers Committee have prepared a programme, which you can rest assured will be both profitable and interesting, and the Entertainment Committee have been no less energetic in securing that measure of recreation and good fellowship for which our Association's Conventions have become noted.

It is realized that one of the valuable features of our Conventions is the bringing together of our various members, where, both by discussions of papers and by individual contact, light may be thrown on the problems which we, as individuals, have to contend with and overcome. Friendships and ties now formed will undoubtedly enable you to secure invaluable assistance in the future.

With a business advancing each year with such tremendous strides as has the electrical industry, it behoves each of us to exert every endeavor to keep up with the wonderful growth and advancement, lest we also be thrown upon the scrap heap of material and men. With such advancement there can be no middle course—we must be either progressive

or retrogressive. We are throwing equipment on the scrap heap which but a few years ago was considered most up-to-date, but is obsolete to-day. Are we as individuals keeping in step with the pace of progress?

To give even the slightest idea of some of the advances that are being made, we need only look back but a space of five years.

In the lighting field, the direct current arcs, the enclosed arcs, the carbon lamps, etc., have been replaced by the magnetites, the flaming arcs and the tungsten lamps.

In the generating apparatus, where units of 1,000 to 5,000 h.p. were considered large ten or fifteen years ago, to-day, wherever possible, and where the size and growth of the system warrants the change, they have been replaced by units of such magnitude as those of the Chicago Commonwealth Edison Company, of steam turbo units with a capacity of 25,000 h.p. per unit, and with equipment on order that will have a maximum capacity of 35,000 to 40,000 h.p. per unit. In the Hydro-Electric Stations in various parts of the Continent, units of a capacity of 15,000 to 20,000 h.p. are not now uncommon.

In the transmission of power equal strides have been made. Two or three years ago the Ontario Hydro-Electrical Transmission system was noted because of the adoption of a potential of 100,000 volts. To-day we have high tension lines in operation up to 150,000 volts. With the advance in the size of systems, and the progress that has been made in translating and protective devices, and improvement in insulation, the transmission voltages of yesterday have become the distribution voltages of to-day.

In the general application of electricity wonderful strides are being made if we could only stop to realize them, until it has become an essential factor and necessity in our daily life, in our homes, in our business and means of transportation. Electric cooking in the home, and other electric housekeeping equipments with their safety, cleanliness and convenience, has passed beyond the experimental stage, and will rapidly become one of the necessities of the future.

The electric vehicle, in many of the larger centres of population, has come into more common use than is generally appreciated. In the City of Denver, for the year 1912, there was one electric pleasure car for every 217 persons, and the estimated increase for the next two years is 300 per cent. The vehicle load netted the Denver Company over 2,000,000 k.w. hours, most of which was off peak load. With increasing distances which the electric car can be run, reducing cost of electric service, with greater usage, greater simplicity, safety and lower insurance rates, etc., it will be readily realized that a great advance will be made in the future, when compared with gasoline as a motive power, the cost of which has been continually upward until it is now nearly three times that of what it was ten years ago.

In addition to the above, it has also been amply demonstrated that after the first year, in cost of up-keep, maintenance and reliability, the electric car has a very material advantage over the gasoline car.

These are but a few of the many advances and changes that are taking place.

With such a development in the use of electricity comes added responsibility to the producer. So dependent have we become on this wonderful agency, that when it fails it ties up our whole industrial and commercial life. How many of us realize what the stoppage of power may mean to our cities, not alone in inconvenience but in actual financial loss to business and employees.

Bearing these facts in mind and having regard to the expanding future development before us, we must take even greater precautions in the desire to insure the service against such interruptions of supply with its resultant inconvenience and financial loss to our consumers. Every year sees its quota of lightning, flood and cyclone, with which various sections have to cope from time to time, and while we may have had an era of prosperity and fair weather conditions, we must always be prepared for the future.

In perhaps no other industry is the rate of return on capital invested so low as in that of Electric Power companies, and these factors of risk, security and growth are deserving of most careful consideration if the investor is to be protected and thus secure the fullest possible development in the future. The inevitable result of inadequate returns and failure to provide for the future must be one of inferior service.

We have to deal with two agencies, each of which are good servants but poor masters, viz., water and electricity. We must ever be watchful, to see that they are kept properly controlled.

Increasing consideration is being given to the development, and retention in the service, of employees; and when we consider the future possibilities that lie before us, we as individuals cannot but feel that we are in the best and most promising field of endeavor that can be found, and that we have, each of us, a man's work and a life's work ahead of us.

This universal growth in the use of electricity does, however, add a burden of responsibility. We realize when the power system fails that everything is practically tied up; the whole life of industry is tied up until such times as power can be restored. I have always felt that the question of rates must be of secondary consideration to that of service. The continuity of service must always be the first consideration, and in the public eye too much attention has been given to the question of rates as being the matter of prime importance. In many industries the cost of power is in some cases lower than one per cent. of the total cost of production and averages from 3% up to 5%, and the continuity of its production is a matter of the very greatest importance and something that must be secured at any reasonable cost.

Our consumers and the public have a right to depend upon our aggressiveness, ability and experience to see that they are given the best possible commercial service at a reasonable cost.

On the other hand, they should also bear in mind that if rates are forced below cost there can be only one ultimate result, and that is a future inferior service and a run-down and depleted system. The longer the delay, the greater the ultimate expense and intervening inconvenience. It has become

generally recognized that competition in Electric service can have only one result, viz., duplication of investment and operating expense without in any way insuring or improving the service.

Our industry is yet comparatively young. We have practically no actuary's figures to look back upon. We see advancement and progress all round, and as a result plants become obsolete and have to be replaced long before they have reached their normal or estimated life of usefulness. How many of our Companies and Municipalities will find themselves in the future in somewhat the same position as that of some of our fraternal insurance societies of the past? Many such societies were forced to the wall as a result of inadequate and unsound provision for the future under a system of management based on apparently the highest ideals of brotherhood. Notwithstanding the apparent disadvantage, the insurance companies are in a stronger position to-day than they ever were before. Their policy holders of to-day are reaping the benefits of their aggressiveness combined with conservatism and security.

Any business must so govern its policy from the beginning that it will be able to carry itself through the lean years of the future when its incoming new business becomes a relatively smaller proportion of its total business. Depreciation and maintenance will become larger factors than earlier in the life of the installation. At the same time, we should, without discrimination to any, so adjust our rates in fairness to all, both investor and consumer, as to secure the greatest possible utilization of our product and the greatest advancement and security of the industry. This can only safely be done after proper regard for the many factors to be taken into consideration.

Gentlemen, I desire to thank you for the honor you have conferred upon me in electing me as your President. It has been my earnest endeavor at all times to advance the welfare of the Association wherever possible, although I have been somewhat handicapped because of the distance of my home from that of the other members of your Management Committee.

I desire to express my appreciation for the assistance and spirit of co-operation of the various members of the different Committees that have so zealously done their duty and without which the success of this Convention and the work of the Association could not have been assured. We have been seriously handicapped, and it is with regret that we look over the roll to note the loss to our Canadian Association of such active members as Pack, Ryerson, Kemble and Kelly, who have gone to wider fields.

I again wish you all a very prosperous and pleasant visit, and trust that you will each return to your different fields of endeavor with a greater enthusiasm for the future, and with the conviction that the Toronto Convention of 1913 has surpassed, if that were possible, all previous Conventions. (Applause.)

The President: I have a letter from Mr. D. R. Street, the Secretary-Treasurer of the Ottawa Company, expressing his regret at his inability to be at this Convention. We will now have the Secretary-Treasurer's Report for the past eighteen months, by Mr. Manser.

Mr. Manser: I am sorry this morning that it falls to my lot to read this Report. Our Secretary has been laid aside from active work and he is not able to be with us, which we regret very much.

SECRETARY-TREASURER'S ANNUAL REPORT.

To the Members of the Canadian Electrical Association.

In presenting my report to this Convention, I have felt that in order to show the true position of the Association it would be wiser to present a statement up to June 30th, 1913, and, in comparing this statement with that presented at last year's Convention, it must be borne in mind that this year's report covers a period of eighteen months against a period of six months in last year's report.

It will be noted also that I have divided the statement into two periods, January 1st, 1912, to June 30th, 1912, and from June 30th, 1912, to June 30th, 1913, as this first period really belongs to the preceding year's work.

The Managing Committee has held three meetings throughout the year—in September, February and April. At the February meeting it was decided to hold the Annual Convention in Fort William and tentative arrangements were made to that end, but it was subsequently decided at a later meeting that this would be unwise, and it was then decided to hold the Convention at Toronto.

Several changes have taken place in the personnel of the Executive during the year. In September the Association sustained a severe loss by the resignation of its President, Mr. R. F. Pack, who removed to Minneapolis to become Vice-President and General Manager of the Minneapolis General Electric Company. Mr. Pack was one of the most enthusiastic workers in the Association and his loss has been severely felt. At this September meeting Mr. W. L. Bird of Fort William was elected President and Mr. Parker H. Kemble was elected First Vice-President. Mr. Kemble unfortunately removed to Cincinnati in February of this year, and the Association sustained another loss, although Mr. Kemble still retained his office of First Vice-President.

The present standing of the Association in numbers is:—

Class "A"	50
Class "B"	450
Class "C"	35
Class "D"	11
Class "E"	73

Which shows the following changes since our last Convention:—

Class "A"	Gain	2
Class "B"	"	2
Class "C"	"	8
Class "D"	"	2
Class "E"	"	19

FINANCIAL STATEMENT.

January 1st to June 30th, 1912.

RECEIPTS.

Cash in Bank and on hand, January 1, 1912	$ 253.68	
Membership Dues	3,599.78	
Interest	6.30	
		$3,859.76

DISBURSEMENTS.

Sundries	$104.91	
Postage	85.00	
Printing	555.97	
Stenographer's Salary	375.00	
Office Rent	95.00	
Office Furniture	150.25	
Exchange on Cheques	10.85	
N.E.L.A. Balance of their proportion of 1911 Dues	733.11	
Secretary's Annual Grant	500.00	
		2,610.09
Balance on hand, June 30th, 1912		$1,249.67

RECEIPTS.

June 30th, 1912, to June 30th, 1913.

Cash in Bank, June 30th, 1912	$1,249.67	
Receipts	1,687.48	
Interest	20.41	
		$2,957.56

DISBURSEMENTS.

Sundries	$ 74.16	
Postage	58.09	
Printing	884.25	
Convention Stenographer	80.00	
Exchange on Cheques	8.30	
Stenographer's Salary	195.00	
Secretary's Salary	500.00	
		1,799.80
Balance on hand, June 30th		$1,157.76

Against this there is owing to the N.E.L.A. for 1912 dues, $1,136.00, but there still remains $2,460.00 1913 dues to be collected.

My resignation is in the hands of the President, and in closing I wish to express my thanks to the Executive for their co-operation, and particularly to express my gratitude to the Honorary Secretary for the advice and assistance he has so cheerfully given me throughout the year.

While I am on my feet I will accompany this with the Auditors' Report.

AUDITORS' REPORT.

Toronto, June 23rd, 1913.

To the President and Members of the Canadian Electrical Association.

We hereby certify that we have audited the Cash Book from January 1st, 1912, to June 23rd, 1913, and found same correct.

R. MANSER.
H. G. MARTIN.

MR. McDOUGALL: I would move that the Report of the Secretary-Treasurer be adopted.

MR. A. A. DION, Ottawa: I second the adoption of the Report. (Carried.)

THE PRESIDENT: Any correspondence?

MR. MANSER: No.

THE PRESIDENT: As the Secretary stated, we have lost during the past few years a number of our active members, especially Mr. Pack, also Mr. Ryerson of Duluth and Mr. Kelly. We sincerely regret their loss to our Association, but we congratulate them that they have gone to a wider field of greater opportunities.

The next item on the programme will be the paper on "Graphic Meters," by G. D. Gratton.

GRAPHIC METERS

By G. D. Gratton
The Electric Power Co., Limited

What is a Graphic Meter? As understood by the electrical profession, it is an electrical measuring instrument which indicates the condition of the circuits, and arranged that this condition may be drawn or traced on a chart by means of a pen or other marking device connected with the measuring element, thereby making a graphic representation of the condition of the circuit. The chart is marked or scaled to represent the value of units of which it is desired to make a record, and is also marked to show the time of the day, in order that the condition which existed in the circuit at any previous time can be ascertained. The chart is caused to move under the printing or pen mechanism by means of clockwork.

There appear to be several different titles for denoting Graphic meters, such as Graphic Curve-Drawing Meter, Graphic Recording Meter and Graphic Meter. Just which is the most correct title seems to be largely a matter of choice. The writer believes that the title Graphic Meter, which is the shortest, is also as expressive as any, for the reason that when the word "Graphic" is used it is understood that a Graphic meter is meant and not an Indicating or Integrating meter.

General Principles and Selection of Meters.

The principles of the measuring elements of graphic meters are the same as those used for switchboard indicating and portable instruments, as follows:

The Kelvin Balance, the Siemens Dynamometer, the Moving Iron, the Induction, and the D'Arsonval. The most common are the Kelvin Balance and the Siemens Dynamometer, which are generally used for alternating-current voltmeters, ammeters and wattmeters, and in some makes for D.C. voltmeters. The dynamometer, moving iron and induction principles are used in various makes for voltmeters, ammeters, power factor, and frequency meters.

Graphic meters may also be said to be of two types, that is, the relay type and the direct-acting type. In the relay type the measuring element does not do the work of operating the pen, but closes a set of auxiliary contacts which close the circuit through the relay coils, or solenoids, that operate the pen. This keeps the pen friction, etc., away from the measuring element, and tends towards greater and longer accuracy, due to lighter moving elements: also the instruments do not require so much power to operate, that is, the shunt losses will be much less, as the instru-

ment does not require as great a torque to operate the pen. It also means considerable saving in transformer capacity to operate the instrument.

In the direct-acting type the measuring element operates the pen directly on the chart, so that the moving coils are obliged to have a large torque in order to overcome the pen friction, etc. This means high shunt losses, and in some makes a heavy moving element. In one make of graphic with a high torque, the moving element weighs over half a pound, and the makers claim that this is done in order to give sufficient damping to the moving element. It was found, however, that unless the instrument is very carefully adjusted that the pen did not follow the fluctuations of a fairly steady load, and on a fluctuating load did not follow the extreme variations in the load, but gave a good average curve of the load. This would be an objectionable feature in some cases and in others all that could be desired.

One well-known make of graphic meter of the direct-acting type, the potential or shunt coils require 100 watts each. In the case of a polyphase wattmeter this would mean a shunt loss of 200 watts. This is a very high shunt loss compared to another well-known make operating on the relay principle, the shunt loss of which is about 8 watts and the power required by the solenoids or relay coils 25 watts, making a total watt loss for a polyphase meter of 41 watts.

The selection of a graphic depends on several conditions, such as the nature of the load, the terms of the contract, and the accuracy by which the load must be measured. If the charges are based on the indications or readings of the graphic, then one should be chosen that has good accuracy and that will remain accurate, even if it is the most expensive. On the other hand, if the graphic is merely intended to show the nature of the load, or to indicate when a peak or contracted load has been exceeded, an instrument that is not so accurate, and probably cheaper, may be used.

Paper or Chart Speed.

The speed at which the paper shall travel is determined by the character of the load to be measured and the duration of the peak. (This refers more particularly to wattmeters.) For instance, a lighting load with a slowly rising and falling peak and generally a peak of rather a long period, a slow paper speed may be used, say 1 in. per hour, with good results. For another example, take a power load consisting principally of mill machinery on which the load is intermittent, such as rock crushers, air compressors, pulp grinders, conveyors, etc. In this case the load will be of a fluctuating nature and the peaks of short duration and will likely occur quite frequently. If a slow speed chart is used a broad line will be traced, due to the fact that the lines made by the pen will overlap, and the centre of the line will have to be taken as representing the peak. On the other hand, if a high speed paper is used the curve will be extended or drawn out and the intervals between the peaks plainly distinguished. If in this instance the contract peak was 10 minutes, it would be better to use the slow speed chart, and again, if the same load was contracted for on a one-minute peak it would be necessary to use a high speed chart in order that

the curve would not be crowded and the peaks overlap. It would be a difficult thing to measure a one-minute peak on a chart having a speed of one inch per hour, as, in most cases, the thickness of the line drawn by the pen would represent a time interval of more than a minute when scaled or measured on the chart, while the actual peak might have been less than a minute. For a one-minute peak a chart speed of not less than four inches per hour should be used. In general, a chart speed of 1½ or 2 in. per hour will suit the majority of cases, and will allow a peak of short duration (not less than five minutes) to be scaled off the chart with accuracy.

Another point that should be borne in mind is whether it is desired to know the extreme variations or momentary peaks of the load, or the average load. This refers to such loads as motor driven air compressor with rapid unloader, mine hoists and other intermittent loads. On a load of this nature a curve traced by a meter with little damping would be rather broad and uneven, depending, of course, on variations in the load. On the other hand, a meter in which the damping could be made very heavy would not follow the momentary fluctuations, but at the same time if the peak continued it would indicate the maximum.

A meter that uses a fairly wide chart, say 5 in. or more, is better adapted to close and accurate reading than one using a narrow chart. Especially is this so in the case of high capacity wattmeters and ammeters. The thickness of the line drawn by some pens may represent a value of 100 K.W. or even 500 K.W., and the line would have to be very carefully scaled in order that the Company may not either over or under bill the customer.

Scale Capacity.

In choosing the scale capacity of a graphic meter it should be so chosen that with the average working position of the pointer or pen it will be at least half way across or over the chart. This tends to better accuracy in reading, and in the case of an alternating current wattmeter this would allow it to operate on a load with a low power factor without overloading the current windings and still keep the pointer well up on the scale; for instance, a 200 K.W. load is to be measured, the power factor being probably about 75 or 80%. An instrument with a scale capacity of 400 K.W. would be chosen, allowing for small increased load and the low power factor. This is quite an important consideration. It is a big mistake to set up any instrument that has a large scale capacity and operated so that the pointer does not move very far from the zero point, for the reason that no measuring instrument is accurate when used so that the pointer is not deflected more than a quarter of full scale value (none of the manufacturers will guarantee their instruments when used below this value); at the same time they should not be operated at more than three-quarters or four-fifths of full scale value for the same reasons as above. In the case of wattmeters there is another point to be taken into consideration, that is, the power factor of the circuit. For instance, an instrument whose full scale value is 400 K.W. is operating on a circuit which requires 300 K.W. at 75% power factor. In this case the pointer would be operating

at three quarters of full scale value, but the current coils would be operating at full current value. If the load increased to 400 K.W. at the same power factor the current coils would be overloaded, which would tend to cause an incorrect reading. Also if the instrument is operating from the secondaries of current transformers, there would be another error due to the transformers being overloaded, as nearly all A.C. instruments are operated from secondaries of either or both current and potential transformers. It is the best practice to select transformers suitable for the present load, allowing for 50% or even 100% increase in load, and when that value has been reached change the transformers for larger ones. As it is only the current transformers that will have to be changed it will not be a very expensive operation. (There are, of course, circumstances and conditions which would not allow of this, so that transformers large enough for the maximum capacity would have to be installed in the first place). When this is done it will necessitate changing the value of the scale. This is not a complicated operation, and if it cannot be done by the man in charge of the meters it can be sent to the manufacturers. The chart will also have to be given a new value to agree with the new scale. All that is necessary is to send a sample of the old chart with the new values marked on it to one of the printers that do this kind of printing. There are several in the field. With one or two exceptions the company with which the writer is connected uses all 5 ampere, 100 volt, Polyphase graphic wattmeters having a full scale value of 1 K.W., and has the charts printed to suit the transformers with which the meter is used, making our own scales and samples of the chart for the printer to work from, or if we do not want to have a special chart printed we use a chart having a value of 1 K.W., and multiply the readings by the ratio of the transformers.

Performance.

For satisfactory performance or operation, graphic meters require more careful attention than probably any other kind of instrument in regular daily use, for the reason that there are more details to get out of order, and as the interior is generally easily got at, it is as easily damaged by Mr. Paul Pry. This and carelessness is the cause of most of the trouble with graphic meters, and it is very doubtful even if very careful instructions were given the operators in charge of the switchboard or station that the trouble would be very greatly reduced. From the writer's experience the majority of operators do not remember verbal instructions for longer than it takes to tell them, and seldom look at printed instructions. It is by far the better plan to let one man look after the graphic meters, even if there is only one meter on the system. He will become well acquainted with the instruments in time and know how to handle them, doing better and quicker work and the instruments will give better satisfaction than when every Tom, Dick and Harry has a crack at it.

Repairs and Maintenance.

This requires a good deal of skill and patience; as a large portion of the work is light and delicate, it should not be attempted by anyone

who has not had previous experience in light repair work. The person undertaking this work should also be a pretty fair mechanic and know what the various parts are for and not be guessing at it; in short he should thoroughly understand the principles of the instrument he intends to repair. This also applies to other instruments than graphic meters. The question of how much repair work should be done on the job and what should be sent to the shop can only be answered by local conditions. If a company has a considerable number of instruments in service it is by far the better method to keep one or more spare meters on hand so that in case an instrument breaks down on an important customer it can be changed. This will save a loss or interruption in charts, and what is more important, a probable loss in revenue, due to a peak not being recorded. This same peak might very easily pay the cost of the extra graphic. In addition to the extra instrument a spare clock and several of the parts that are likely to require renewing should be kept on hand so that repairs can be quickly made. Generally speaking, only the smaller kind of repairs should be made on the job, such as replacing jewels, pivots, suspension wires, winding contacts, cleaning penpoints, etc. It will be found cheaper in most cases, where it is necessary to repair the clocks, to change them and do the repairing in the shop. Also in cases where it is necessary to do any recalibrating due to burn-outs to the leading in springs, resistances, etc., it is better to remove the instruments and do the work in the shop. It is a hard job at the best to calibrate a graphic meter on its load, as the load is almost certain to be more or less variable, and even if a temporary load is rigged up it would have to be regulated in some manner, and it will take a good deal longer to do the job, and it will probably not be as good a job, as if done in the shop where everything is convenient. It will nearly always be the cheapest, even if it does mean an extra trip to reinstall the instruments, to repair it at the shop. An argument that might be used against this is that the calibration might become changed in shipment. This is almost entirely a question of packing. The writer has calibrated and shipped graphic meters without the slightest change in calibration. At the same time he has seen instruments seriously injured through careless packing.

Cost of Repairs.

This is an item that should be given plenty of consideration. It is very poor policy to buy a graphic that, while the first cost is low, is all the time in need of repair. This does not necessarily mean replacing broken parts but may mean frequent checking, resetting zero, repairing the rewinding apparatus for the used chart, cleaning relay contact points, etc. With this company the largest item in the cost of repairs is the labor. With some companies transportation is a large item. The cost of actual new repair parts is not very great, the largest item in this case being new pens. As stated above the largest item in the cost of repairs is labor. In a way this may not be strictly true, as with some companies the largest portion of this item is the time it takes to get to and from the job, for the reason that some of their customers, substations or power

houses are some distance away from headquarters. So far as the time to do the actual work of repairs is concerned, it is not a large item, being from $1\frac{1}{2}$ to 5 hours. The average time might be placed at 2 hours. As stated above, any job that is likely to prove a big one is sent to the shop and in this case the labor or time may be anything from one-half to several days.

The cost of doing various kinds of repairs, as found by the writer, is given in the following list:—

COST OF REPAIRS—LABOR ONLY.

Hand-wound Clocks	\$1.60 to \$4.00
	Average \$2.00
Motor-wound Clocks	\$0.75 to \$3.50
	Average \$2.00
Clock Motor	\$2.00
Paper Mechanism	\$2.00 to \$6.50
Replacing Pivot	\$1.80
Repairs to Pen	\$1.00 to \$2.00
	Average \$1.80
Dotting Mechanism	\$1.50 to \$4.00
	Average \$2.00
Pen-lifting Mechanism	\$1.50
Pen Shaft Bearings	\$1.00
Cleaning Jewels and Contact Points	\$2.00
Repairing Resistances	\$5.00
Repairing Control Circuit	\$2.00

The most common of the troubles which may be looked for and their remedies are given below:

Stoppage of Hand-wound Clock.—This is generally due to the clock getting dirty and sticking, and as a general rule they may be cleaned by washing thoroughly with gasoline or benzoline with a small, long-bristle paint brush. After washing, oil thoroughly with watch oil. Nye's watch oil is very good for this work. Some makes of hand-wound clocks will stop if wound too tight, as the springs seem to bind instead of unwinding. Remedy: Remove the escapement and start the clock unwinding, being careful not to let it unwind too fast.

The stoppage of motor-wound clocks may be due to several reasons, the chief of which are broken winding contacts, winding dogs, and the pin in the main-spring shaft that moves the winding dog. The only way to satisfactorily repair these is to put in new parts, as they are not expensive.

Zero Shift.—By this is meant the shifting of the pen from the zero line. This company has found this to be a common occurrence in one make of graphic meter. It may be due to several causes—change of temperature, shifting of control springs, violent overloads or surges, misplaced pen or chart, friction, etc. In some cases where the temperature effects are noticed, it is due to the fact that the instrument is located in either a hot or cold place, such as a substation with no means of heating

in the winter time, or in the hot weather poor ventilation. This is almost certain to cause a change in the tension of the controlling springs. The only remedy is to adjust the springs to suit the temperature each time there is a considerable change. It goes without saying that a meter of this kind should not be on a load that it is desired to measure with any degree of accuracy. In the case of the relay type of meter, this trouble very rarely develops, and as there is always provided a mechanical means of correcting it, it is very little trouble to do so.

If the control springs have shifted they will probably be found loose. Move them till the pointer comes to zero, and tighten.

If a violent overload has been the cause of it, the pen shaft will probably be found slightly bent. Straighten shaft until the pen comes to zero.

Misplaced pen and chart can easily be detected by an examination, and is as easily fixed.

Friction may be caused by broken jewels, pivots, pen bearing too heavily on chart (this applies principally to the direct-acting type), in one type the suspension wire may have stretched or moved and the moving element be rubbing on the lower jewel.

Meter Does Not Register the Correct Amount of Energy Passing in the Circuit.—This may be due to several reasons—-improper connections, blown fuses, grounds on the secondary of the current transformers, burnt-out or open-circuited potential coils, burnt-out or open-circuited resistances in series with the potential coils. The best way to locate the trouble is to start by testing with a lamp to see if the potential is on. If this is found off, the fuses are burnt out. Replace with new. If the potential is found to be on, try disconnecting the potential leads to the meter and see if there is a spark when the lead is touched to the meter terminal. If there is no spark, the potential coil is almost certain to be burnt out (and whether this will have to be shipped to the manufacturers or repaired by the company depends on the ability of the repairman). If there is a spark, the potential coil is O.K., and the trouble will most probably be improper connections. Trace the connections and reconnect if necessary. If the connections are O.K., look for a ground on the secondary of the current coils or wiring. The effect of a ground on the current wiring is to shunt the current transformer and cause the meter to read low. This is especially so in the case of polyphase circuits where two or more current coils are used.

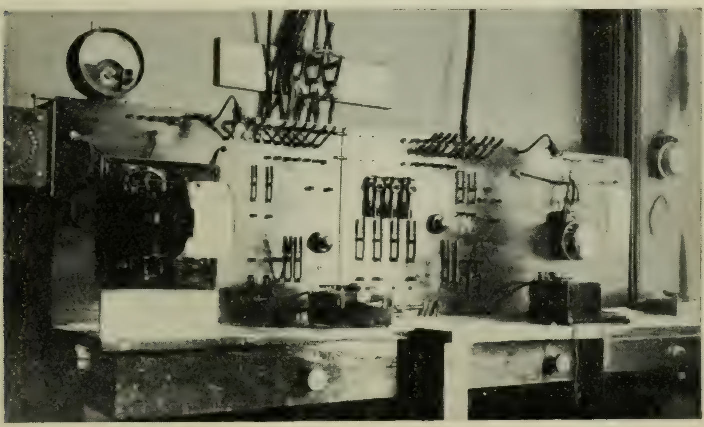
There are numerous other causes of trouble and their remedies, but it would require too much space to mention them here.

Cost of Operation.

This is the cost of repairs, testing, charts, current losses in potential and control circuits, ink, etc. As to which is the largest item depends on local conditions, though, generally speaking, it is the cost of repairs and testing that will be noticed by the management and considered as the largest item, even though the largest cost may easily be the cost of the current required to operate the instruments. Consider the case of

a polyphase instrument that requires 200 watts in the potential circuit; this loss goes on every hour, year in and year out, and with energy costing 1c. a K.W. hour, means a loss of $17.52 a year, and in a station, or a number of stations, where a large number are used, this loss amounts to a considerable amount, and is worth considering. The cost of testing depends on how often the instrument is tested and the cost of transportation. The same applies to the cost of repairs. With our company the largest part of this item is transportation and the time getting to and from the job.

The cost of charts varies with the kind and style used and the quantities ordered. The cheapest way to get the charts is to buy a year's sup-



Meter Testing Board

ply for all the graphics in use. By doing this a much better figure can be obtained than by purchasing a few at a time.

Testing.

A large chapter could be devoted to this subject and then it would not be any too fully covered, but the writer will only make a few general remarks, relating chiefly to wattmeters, of which there are more in use than probably all the other meters together. The following remarks apply to polyphase instruments.

Shop Testing.

A convenient rack should be made up, on which a graphic meter can be quickly hung. This company uses a hardwood board arranged on the front end of its service meter testing table, and drilled so that any make of graphic meter can be mounted in a few minutes, and the terminals, connections, etc., are easily gotten at for repairs and recalibration. The

board itself is fastened to the testing table by means of straps and bolts with thumb screws, so as to be easily removed or set up. The testing table itself, which is shown in cut, is made of heavy dry pine, well shellacked and varnished. The current supply is 3 phase, 3 wire, 100 volts, 60 cycle, supplied from a bank of 10 K.W. transformers and 150 volt, direct current supplied by a 6 K.W. motor generator set. The table is so arranged that it can be used as two independent boards for single phase work, or can be combined for 3 phase work. Any power factor from zero lagging to zero leading can be obtained. From the diagram of connections it would appear to be rather complicated, also there is the possibility of making dead short circuits. As a matter of fact, in actual operation, the board is very simple, and if a short is made it does no harm, as the board is protected by circuit breakers which are very effective. These have operated time and again on a short when a lamp fuse did not blow. In addition to this the standards are protected by a switch that short-circuits the current winding, making it impossible to do any serious damage. No testing table of any description should be without circuit breakers, as they are the very best of protection. It would take too much space here to describe the testing table in detail, so that the brief description given will have to suffice, any more than to say that it was designed expressly for quick and accurate testing of single and polyphase watt-hour meters, and, of course, can be used for testing any other kind of meter.

Every graphic, when received from the factory, should be tested, for accuracy of scale indications, correctness of chart ruling, balance between elements, and thoroughly examined for defects of any kind. To test for scale accuracy, connect in series one element at a time with a standard indicating wattmeter on a single phase circuit. The indications of the standard wattmeter, multiplied by the ratio of the transformers with which it is intended to use the graphic, should equal the graphic reading if it is correct. If no transformers are to be used, then the indication of the standard should be the same as the graphic; make a note of the errors, if any, and then test the other element. If there is no difference between the readings of each element, then they are equally balanced. If the difference is very great, it should be corrected by either adding a little more resistance to the resistance, in series the potential circuit that reads the highest, or taking a little away from the low reading element. Which of the two adjustments should be made depends on whether the high or low reading is correct; if the high reading is correct, then the adjustment should be made on the low reading element; if the reverse is the case, then adjust the high reading element; if both elements are high, then both will have to be adjusted by adding more resistance. It should also be tested on zero power factor if possible, but as it is very easy to get a 50% power factor on a 3 phase testing circuit, it will generally be more convenient to test at 50% power factor, and if the graphic is found correct at 50%, it will be correct at zero power factor or vice versa. It is **very important** that a polyphase wattmeter should be correct on power factor, and it is equally so that they should be correctly balanced. It is not enough to think that if one element is a little low and the

other just as much high, that the average error will be zero. This would be the case if the power factor of the load were 100%, but as this is never the case on a power load or even a lighting load, there will be an error depending upon the power factor.

It should also be pointed out that both potential circuits should be connected in parallel when making these tests, the same as is done in testing watt-hour meters, for the reason that in some makes of graphics one element affects the other, while in other makes there is no interference between elements, so that it is the safest to connect both potential circuits. Care should also be taken to see that the current is passing through the windings in the proper direction, otherwise there will probably be an error that would not exist if the instrument were properly connected.

Another method of testing the balance between elements is to buck them; that is, connect one element to read backwards, but this is not as satisfactory as testing each element separately, for the reason that the pointer may come to zero and yet the elements are not balanced, as would be the case if one element was exactly as much too low as the other is too high.

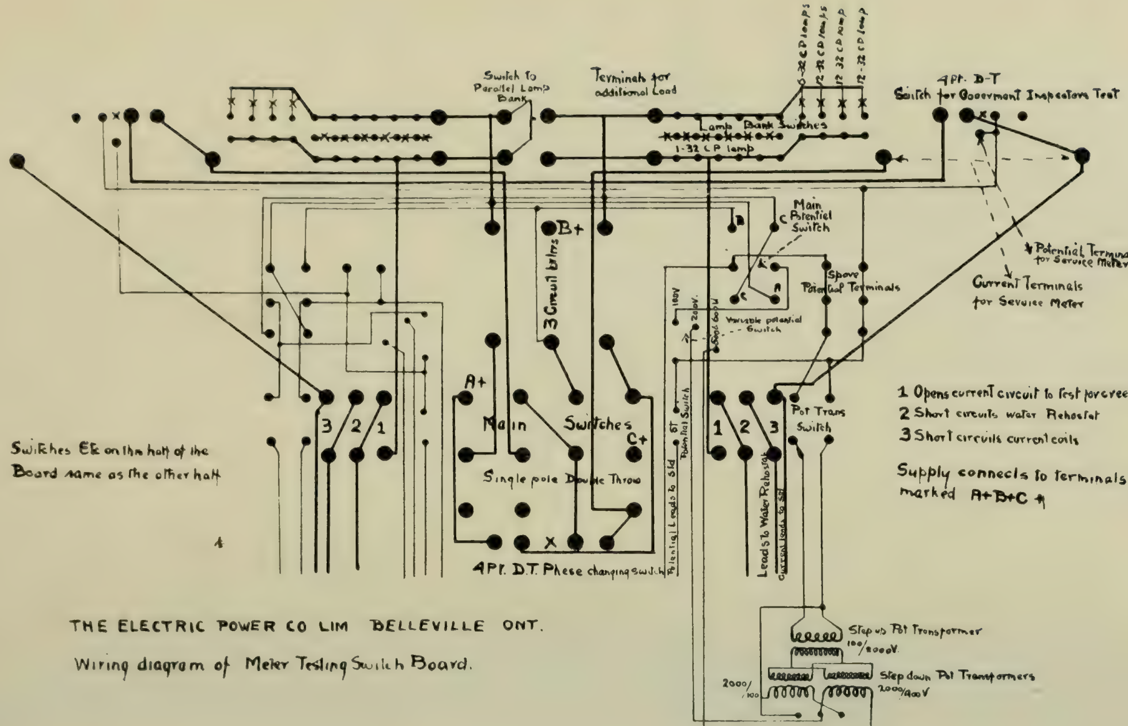
The charts should be examined to see that the ruling is correct as to the spacing, etc. If not correctly ruled there will be an error in taking the reading off the chart.

The meter should be very carefully examined for mechanical defects, such as loose connections, improperly adjusted clocks, winding attachments, re-rolling and paper mechanism. If none of these troubles can be seen the instrument is in apparently good shape. However, it is a good plan to set it up and let it run for several days in order to bring out any defects that exist.

Testing in Service.

This generally consists of comparing the readings of the graphic with a portable standard, and noting the error. The test is generally made by connecting the standard in service with the instrument to be tested, on the same load, using the same instrument transformers when they are used, which is generally the case, though in some cases it is necessary to use a separate set of portable testing transformers. This is only done if there is any reason to doubt the accuracy of transformers to which the graphic is connected. It is much more convenient to use the same transformers. If it is desired to test the instrument as a secondary meter on an artificial load, the switch board lights may be used or a portable lamp bank.

A few words might be said about the method of connecting the standard in series with the meter under test, particularly when using the same current transformers. Until quite recently very few power boards were equipped with any kind of means for testing, and the tester had to do the best he could to connect in, and frequently got a shock for his trouble. It is warm work and dangerous, to connect in series with the secondary of a current transformer, as a slip may mean a violent shock and injury to the instrument and transformers. In addition to this, everything else



THE ELECTRIC POWER CO LIM BELLEVILLE ONT.

Wiring diagram of Meter Testing Switch Board.

is alive, and it is a very awkward proposition to wear rubber gloves, as the wires, terminals, etc., are small. The writer has seen several accidents of this kind. In one case three instruments were damaged, and the tester's hand severely burnt. Very few current transformers are provided with suitable or convenient means of short-circuiting them if necessary. One manufacturer provides a piece of solid copper wire, which always breaks after it has been used a few times, and in this particular make the secondary terminals are so located that it is often impossible to get at them after the switchboard has been put in operation. It would be very much appreciated by those who do the testing, and the trade in general, if the manufacturers of current transformers would equip them with a small knife or plug switch for short-circuiting them, as there is hardly a switchboard in operation that the meters do not have to be tested, etc., at some time. All of the switchboards being erected by our company are provided with testing plugs, which, when supplied with the board when new, add very little to the initial cost, which is very easily saved in the time saved to make the connections to test, over the old method. Our company is also equipping all of its power boards with test plugs that were not so equipped originally. The cost of doing this will very quickly be saved in the time saved making the connections and test, and, aside from this, the safety and convenience is very much increased.

The following points should be taken into consideration when deciding to purchase a graphic wattmeter.

1st.—The size of the contracted load and the possibility of a quick increase.

2nd.—The kind of load, whether steady or intermittent.

3rd.—The power factor of the load.

4th.—The length of the contract peak, and its relation to the actual peak. This is in order to determine the correct chart speed.

5th.—Is it desired to know the maximum fluctuations of the load or the average?

Records.

A system of records, either cards or loose-leaf system, should be kept of all the work done on the instruments. This will prove invaluable, for a reference as to what repairs have been done, when tested, cost, etc.

In conclusion, would say that from this company's experience, we have not found the best any too good, as there is not yet a perfect graphic on the market. There is room for improvement in some detail or other.

One fact that is very noticeable is the lack of information regarding this class of switchboard indicating instruments as regards repairs and recalibration. With the exception of the manufacturers' bulletins there is practically nothing to be got. A good book on this kind of work would be very much appreciated by meter men especially, and the profession in general.

This article should not be taken as covering all the points and details of graphic meters, but more as a review of the experience and methods followed by the company with which the writer is connected.

DISCUSSION.

The President: I am sure we very much appreciate Mr. Gratton's very valuable paper on "Graphic Meters." Graphic meters have probably come to the rescue as between operating companies and the consumer, and indicate to the consumer in a way in which no other meter has been able to do in the past just what are the conditions of load. This paper of Mr. Gratton's I consider a very valuable one, and I think we should not let the opportunity go by without having a really live discussion on the value of the graphic meter. He has brought out a number of valuable points with reference to the selection of meters, which indicates that he has been through the mill and knows what has to be contended with.

I would like to call upon Mr. Brown of the General Electric Company to start the discussion on Graphic Meters.

Mr. H. S. Brown: Mr. Chairman and Gentlemen—Mr. Gratton's paper has covered the ground so thoroughly that it leaves very little to be said in the discussion. There are a few points, however, that I would like to bring out.

In connection with direct acting versus the relay type Graphic Meters, Mr. Gratton brings forth the advantage of the relay type on account of its low consumption of current. It is true that the measuring element of the relay instrument takes somewhat less power to operate it than does the direct acting type. This, however, is of small advantage, since for alternating current work it is preferable to operate instruments from a separate set of current and potential transformers, or from a set of transformers which operate a small number of meters. The direct acting instrument with which I am most familiar, does not take excessive power to operate. A standard current transformer will run this curve drawing wattmeter, an indicating wattmeter, an indicating ammeter, and integrating wattmeters. For direct current, the total amount of power consumed by the instrument, from a standpoint of cost, is not material, as the power taken by the measuring circuit in the relay type of instrument plus that in the exciting circuit would more than equal the total power taken by the direct acting type.

In one of the relay type instruments on the market, the Kelvin balance principle is used. It is electrically very accurate, but its characteristics are exactly the same as the dynamometer type of instrument used in one of the direct acting instruments. Both instruments are practically free from temperature, frequency, and wave form variations. The Kelvin balance instrument is astatic as to uniform fields only, and is affected by stray fields which are not perfectly uniform so as to have equal and opposite effect on the two sets of coils. In the particular dynamometer direct acting instrument referred to, the element is entirely enclosed in a laminated iron shield, so that it is absolutely unaffected by stray fields whatever, whether uniform or not.

The relay instrument appears to be more dead beat than the direct acting instrument, in that there is a time lag between the movement of the solenoids operating the pen and the movement of the measuring element making contacts. The pen does not come to a definite position indicating

the exact reading, until the measuring device has made contact and the solenoids have moved the pen until the pole is balanced by spring. For this reason, the instruments appear to be more dead beat, in that they do not follow rapid fluctuations of the circuit.

The direct acting instrument, with which I am particularly familiar, is damped by a copper disc acted upon by permanent magnets, and since it is direct acting, the pen arm follows exactly the variations of the circuit, and although the curve may show larger variations than the relay instrument, they are, however, the exact variations of the circuit without any time lag between intervals; that is, in case the voltage should rise suddenly on a voltmeter, and then drop suddenly, the relay instrument might not catch this rise, as the contact device and solenoids would not operate quickly enough.

The direct acting instrument has the advantage of being very much simpler in construction. There are no make and break contacts to give trouble, due to sparking, pitting, and burning. The direct acting instrument has maximum sensitiveness at all times, and will undoubtedly follow more closely the rapid variations in the circuits to which it is connected.

The President: We would like to get the views of the manufacturers, if any are present.

Mr. Smith of Belleville, would you like to give the point of view from the operating end? You are, no doubt, running up against some of the difficulties in convincing your customers of the justness or unjustness of your bills.

Mr. Smith: Mr. Gratton has given our experience; some of the other companies could give their experience.

The President: All will recognize the importance of this question of accuracy which Mr. Gratton has brought out; even 1% or 2% becomes a very important one, and one which must be considered from all points of view, and its aggregate effect on our financial returns both from the operating company and the consumers' point of view. Mr. Dion, could we hear from you in reference to operating of graphic meters?

Mr. A. A. Dion, Ottawa: I would rather someone who has had more practical experience with these instruments would speak of them. We have little or no experience with graphic meters.

I would like to congratulate the writer, however, on giving us a paper which is practically a handbook on the operation of graphic meters, containing a good deal of information based on practical experience, which would be of great benefit to operating men; things that he probably cannot get anywhere else. In that regard the paper is of very great value. Mr. Keyes is here from our Company; he has had some little experience with these meters. Perhaps he would like to say something about them.

Mr. Keyes, Ottawa Electric Co., Ottawa: We have only two recording instruments in use at the present time one being a recording voltmeter and the other a recording wattmeter, which is of English make. We have found the wattmeter to be satisfactory for the purpose we use it—that is, taking records of loads on large power customers. The suggestion that Mr Gratton has made appeals to me very strongly, particularly the one re the manufacturer furnishing information as to the construction and connection

of the meter. If a meter is to be cared for intelligently too much information cannot be given concerning it.

Then, as to testing instruments on power house switchboards, his suggestion that there should be a short-circuiting connection on the series transformers is an excellent one.

THE PRESIDENT: If there are any other manufacturing or operating points of view, we would like to hear representatives this morning.

MR. MAGALHAES, Toronto Electric Light Company: In regard to the statement made by Mr. Gratton, page 19, top of the page—a very important statement is here made about the selection of the capacity of the transformer, to which the meters are connected. I would like to ask the writer of this paper what would be the greatest per cent. over normal load he would advise the capacity of current transformer, over the normal capacity of the load, so that the instrument would register accurately. In this case he says: the best practice, select a transformer suitable for the present load allowing, with 50% or even 100% overloading, increase in load. In this case am I to understand that 100% increase or a transformer capacity of 100% greater than the normal output of the plant would be suitable for the instrument so that accurate readings could be taken, or would you recommend 50% over?

MR. G. D. GRATTON: In reply to this question would say that the idea is to select the transformers of such a capacity that the pointer or pen will with normal load on the circuit be at least half-way across the chart, at which point good readings are obtainable and are accurate. With transformers so selected there will be plenty of room for a 50% or perhaps 100% increase in load depending on the power factor. From the experience of our company I think transformers 50% or 100% larger than actually required at the time of installation would be amply large enough.

MR. H. S. BAKER, Ontario Power Co., Niagara Falls: I would like to commend Mr. Gratton's remarks on facilities for testing meters, for getting in on series circuits of the graphic without opening the transformers and providing simple means of getting connection with the meters. It is certainly very awkward in most appliances. I think it is a good idea to recommend better facilities for getting connections to the meter in place.

In regard to the full scale capacity of the meter in regard to the present load, of course one load may be very steady and probably 20% margin would be sufficient to allow, where another load may be subject to severe peaks and require greater margin. But it seems to me that the power factor consideration referred to by Mr. Gratton is not very well taken, in that a meter that is rated 5 amperes ought to be able to stand 50% overload; in other words, should stand full scale kilowatts at perhaps 70% power factor of the load. It does not seem that any consideration ought to be taken into account for power factors above 50% as effecting increased amperes on meter before the meter gets the full scale.

Another point I would like to raise is in regard to his bucking one phase of meter against the other. It seems to me in most cases that is a very good method. Now, Mr. Gratton speaks of one element of meter being perhaps a shade high and the other perhaps low, and the two errors offsetting each other in the bucking test. It does not seem to me that point is well taken.

Taking a specific case, one element of a meter is 1% high and one 1% low; when you buck one phase against the other one is reading backwards; one element of the meter would be forward say 99 k.w. and the other would read backwards say 101 k.w. Then we have a 2 k.w. difference showing on the scale, being the difference between the values of the two halves of the meter.

In regard to interference on any watt meter, not only graphic, this raises the point of whether it is entirely satisfactory to parallel a shunt and run single phase calibration, because as a matter of fact the interference is not quite the same with single phase connections as it is with three phase connections on the shunt.

The Ontario Power Company have found it quite practical to run regular calibrations on all outside graphic meters without the necessity of bringing the meter into the factory. It seems to me it is such a big job to take the meter off the board, that it is seldom advisable to bring meter to headquarters. Of course different companies have different layouts and some have not far to bring the meters to headquarters.

THE PRESIDENT: That is where the value of our discussion comes in. The paper may be written from one point of view under certain conditions and another company may be operating under entirely different conditions.

If any member would like to ask Mr. Gratton any questions we would like to hear from him.

A DELEGATE: Has any member here had any experience with the printing attachment on meters?

MR. GRATTON: We have tried out one printing attachment and it did not turn out very well.

THE PRESIDENT: The time is now drawing near for limiting the discussion of this paper. I am sure Mr. Gratton will be very glad to give any further information to any of the members.

Personally I desire to say to Mr. Mudge, who is Chairman of the Papers Committee, that I think the Association owes to him and his Committee a deep debt of gratitude for the efforts they have made in getting out such a really good list of papers, and if the first paper is any index, I am sure we will all have a very interesting and instructive Convention. We owe our thanks to Mr. Gratton for his very valuable paper.

The next is a paper on "Integrating Wattmeters with Recording Attachments," by H. S. Baker, Ontario Power Co.

INTEGRATING WATTMETERS WITH RECORDING ATTACHMENTS

By H. S. Baker
Of the Ontario Power Company

Electric meters for registering peak loads, in general, may be classed under three headings:

First—Indicating meters operating pens, known as "Graphic Recording Meters," which give a continuous record on a paper chart of the momentary values of the power at every instant of time.

Secondly—Integrating Demand Meters, which sum up the kilowatt hours over given intervals of time and register the kilowatt hours consumed in each interval. This registration may be by a pointer on a dial which must be reset by hand when the reading is taken, or it may be by the rotation of a disc carrying type figures, which are printed off on a paper chart at the end of given periods; or it may be by the deflection of a pen from the zero line on a strip of paper which is passing through the meter.

Thirdly—Heavily-damped Indicating Meters are made for registering peak loads whose indications approach the true present value of the power at a rate which is proportional to the difference between the present indication, and the present true value of the power. The maximum swing of the meter is taken as the peak load.

The Watthour type of meter possesses a distinct advantage over the indicating type, in that the watthour meter takes accurate account of sudden swings of the load (such as when motors are started), which the indicating type does not. If the disc speed lags slightly behind true speed on sudden increase of power, it also overshoots an equivalent amount on decrease.

Both the watthour type and the graphic indicating type possess the advantage over the third mentioned type, in that the relation between the actual power and the theoretical registration of the meter is much more easily covered in the wording of power contracts.

A form of integrating demand meter developed by Messrs. S. Piek and R. C. Downing (of the Niagara, Lockport and Ontario Power Company, Buffalo, N.Y.), which graphically registers integrations of power during one minute or greater intervals, will be described below.

The general idea of using a watthour meter mechanism to drive registering or printing devices, is a number of years old, and various arrangements have been used to register the total rotation of the discs in given intervals of time, without interfering too seriously with the accuracy of the speed of the discs. For intervals of five minutes and over, it is not

difficult to make such registrations with reasonable accuracy, because it is not necessary to work on as high a speed spindle of the gear train as it is for one minute intervals of power.

In the Niagara-Lockport meter, a Westinghouse watthour measuring element is used, and the clutch device which operates the recording mechanism is upon a shaft which rotates once per one hundred revolutions of the meter shaft. The total retarding force of the clutch mechanism amounts to about two per cent. of the full load torque of the meter, and by compensating for this by the friction adjustment of the watthour element, quite accurate results are obtained under running conditions where the peak load registered is ten per cent. or more of the full scale deflection of the meter.

On the clutch shaft an electrically released clutch is mounted, which remains closed for an interval of one minute. A contact operated by a clock then closes, and releases the clutch for a length of time sufficient for the clutch to disengage and be pulled back to zero position by a soft spring. The opening of the clock contact again allows the clutch to close and be driven for another minute by the watthour element. An arm, mounted upon the driven half of this clutch, engages a pen mechanism. The pen mechanism is so arranged that the linear deflection of the pen in a direction at right angles to the travel of the paper is proportional to the number of revolutions of the clutch, which engages the recording element with the rotating spindle of the watt-hour meter. The deflection of the pen at the expiration of the time element selected for the measurement of the demand therefore measures the kilowatt hours consumed, or, in other words, the "integrated demand" during that time interval. Instead of entirely resetting the pen at the expiration of each such period to zero position, the pen is only partially returned, but the pen is reset to zero or near it every six hours by a separate electro-magnet energized, through a corresponding six-hour contact on the clock. The current from this six-hour magnet also passes through the clutch magnet, so that the clutch will be open when the pen is resetting to zero. The six-hour reset of the pen serves to mark off time on the chart, and a time and date are marked when removing charts from meter.

The chart in these meters is registered on a strip of paper 5½ inches wide and 45 feet long, passing through the meter at a rate of one foot per day. At this paper speed of one-half inch per hour, the clock which drives the paper through has relatively little work to do, thus reducing clock trouble due to driving of paper. The holes in the edges of the paper are done away with, also the crosswise marks giving the hours. The paper has only one line on it, (namely, the zero line), and is pulled through the meter between rubber rolls.

In "graphic recording meters," (using indicating rather than watthour type of elements), a greater paper speed is necessary to avoid destroying the one-minute peaks, due to the width of the pen line. In th Niagara-Lockport demand meter, the deflections are measured bot' calibrating and in billing, from the top edge of the zero line, to edge of the ink line drawn by the pen. Thus, no matter how paper travels through, the reading is not affected. The

tegrated peak of power is represented by the momentary peak on the chart, which is not affected by paper speed.

The clock is wound electrically from the potential circuit feeding the meter, or some other potential circuit, every 14.4 minutes, but a no voltage release is provided which connects the clock winder to a set of dry batteries whenever the voltage drops off the meter, due to customers' switching or otherwise. Thus the clock continues to run whether the meter is alive or dead.

Another no voltage release is provided, which closes a contact that operates the clutch magnet as soon as voltage is again fed to meter, thus avoiding the registering of a fraction of a minute of power before shut down, plus another fraction after livening up, which might amount to nearly two minutes of power.

The travel of the pen point across the paper is an accurate straight line, and its motion is proportional to the rotation of the disc, thus giving a uniform scale of kilowatts on a chart whose ordinates are straight lines. It has been argued that a peak might be lost, due to its being partly in one minute and partly in another, as registered by the meter. This is quite true, but, in actual practice, there are plenty of peaks that fall well within one of the minutes measured by the meter, and in comparing the demand meter charts with graphic charts on same load, it is not noticed that there is any loss due to this point.

However, by going into greater complication in construction, the meter can measure several sets of one-minute intervals, arranged so that the minutes in the different systems overlap each other. This is actually done in earlier types of meter built on this general principle. A soft spring is attached to the pen mechanism, giving it a slight tendency to creep towards zero, due to any vibration which may occur. This insures that the pen will not, in any event, creep away from zero and register false peaks.

The following advantages are claimed for this meter over ordinary types of graphic meter:

(1) Reduced interruptions to meter chart, due to clock and pen trouble.
(2) Increased permanency of calibration.
(3) Increased accuracy in reading of peaks, on account of peaks on chart being perfectly definite.
(4) Reduced maintenance expense.
(5) Determining of peaks on a K.W.H. basis.

DISCUSSION.

The President: Mr. Baker's paper is now open for discussion.

A Delegate: I would like to ask Mr. Baker if he considers that the Central Station is interested in all the peaks that occur during certain periods, or are they not simply interested in the maximum peaks? For instance, this instrument measures several peaks fairly accurately that will occur in an operation. Now, the maximum load for any ten minute period or any

one minute period, as the case may be, is the only one that the Central Stations are particularly interested in, and that is the load on which they are going to base their charge. Is the game, therefore, worth the candle to have this elaborate scheme of charts indicating probably 300 or 400 peaks approximately the same? Is that record of any value or of sufficient value to warrant the extra expense of the instrument and the extra expense of keeping these charts and reading them?

Mr. Baker: The Central Stations are interested more or less in all the peaks, for station record, and to show the general run of customers load, to corroborate maximum peak. As a matter of fact, it is just as easy to register all the peaks as to register the one maximum peak, in fact, a little easier, and the advantage of having what corresponds more or less to a graphic chart of their load, keeps general tab on their load factor and so on, the Ontario Power Company considers it well worth while. Of course we have to pick out the one peak—that is, the maximum peak. That requires very little extra time in the clerical department in making up the bill. But we consider it well worth while to get in all the peaks, where it can be done at practically no trouble.

A Delegate: I understand then this instrument is not going to cost any more than one that will indicate only the one peak?

Mr. Baker: No, I don't think so.

A Delegate: How about your renewal of charts and putting them on?

Mr. Baker: The meter only uses one foot a day and that is only a matter of 25 cents expense for paper every month and a half.

The President: This question is a very valuable one to the company as well as to the customer who should have some check and record of his conditions, and best means of adjusting any abnormal conditions. I would like to ask Mr. Baker, has he been long enough connected with it to tell us of the difficulties of initial manufacture and has it been in actual operation on customer's premises?

Mr. Baker: The meter has been out for six or eight months.

Mr. Maclachlan: I think possibly the President's contention that to convince a customer that the load is the real load and to show him at what time of the day that load occurred, is one of the very important points beyond the technical conditions of the meter itself. It is one of the most difficult points to convince a customer you are really billing him for what is used.

A Delegate: I would like to ask Mr. Baker if in this type of meter a change to, say, twenty minute peaks can be easily made?

Mr. Baker: The meter is for one minute peak or five minute or twenty minute, whichever you like, according to gears used. It is a simple change to put in a different clock if desired.

The President: Any further discussion?

Mr. McDougall, seconded by Mr. Maclachlan, moves the adjournment.

FIRST DAY—AFTERNOON SESSION.

The President: The afternoon Session will now begin with the reading of a paper by B. E. Rowley, Hotpoint Electric Heating Company, "Organization of an Appliance Department."

ORGANIZATION OF AN APPLIANCE DEPARTMENT

By B. E. Rowley
Of the Hotpoint Electric Heating Co.

Introduction.

It has been stated at light and power companies' conventions that under present day conditions the dealings of companies with their consumers carry obligations and responsibilities far beyond anything dreamed of in the old regime.

If it is your desire to build up and foster a spirit of friendliness and confidence on the part of your consumer it is essential that you take the initiative.

When through your representatives you give smiling greeting to every one of your patrons it will go fully as far toward establishing the relationship you desire as will a cut in lighting rates.

Make your appliance salesman a part of your "service."

Your appliance salesmen, through self interest, are certain to be liberal with their smiles and keen at overcoming any prejudices against you.

You might emphasize your attitude of friendliness by instructing them to make careful note of complaints and see that the proper department follows and adjusts them.

During the winter months particularly, fifty per cent of the women are telling their neighbors that their light bill is outrageously high. At least forty per cent of this number may be convinced to the contrary by a man who has been properly coached.

Much irritation is caused, unknown to you, by hurried supply clerks in answering complaints and in talking, more particularly over the telephone, with unreasonable customers.

This unfortunate frame of mind on the part of the customer may be largely corrected by a salesman whose first effort, if he hopes to make a sale, must be directed toward convincing his customer of the friendly attitude of the company and in getting her in an amiable frame of mind.

Just recall the time and money you have spent or may yet spend in moulding public opinion on these phases of your business; revision of rates, poles vs. conduits, franchises, tax assessments, municipal ownership and incidentally, appraisements, competitive companies, pole permits and regulations, objectionable ordinances and other vexing problems.

The determination of all of these subjects is either affected or influenced by public opinion.

If you employ the right calibre men for a house to house canvass and they are properly instructed, the day is certain to come when at a critical point their efforts will have turned the scale in your favor, and then, just for good measure, they are actually making revenue for the company while so engaged.

Demonstrations.

Public demonstrations are profitable as they educate the ladies in the use of appliances and are the means of making many sales.

A large attendance can always be obtained by sending out numbered announcements and offering one appliance free to the lady who has the prize-winning number. These announcements have printed upon them a list of the appliances to be demonstrated and the invited guest is instructed to mark with a cross the one she prefers. She then signs her name and address and these cards are collected upon her arrival and at the conclusion of the demonstration the prize is awarded to the one holding the fortunate number.

These cards are later distributed among the salesmen and are used as leads for future business. If this plan is followed in conjunction with an active house campaign each will help the other and the returns will be highly satisfactory.

A demonstration of appliances makes an impression that will stick in the minds of those who witness it for many years. They are there made to realize the great strides being made in Domestic Science.

A half hour talk should be given on the use of electrical appliances generally and followed by a practical demonstration by capable demonstrators of each appliance. Toast can be quickly prepared and served. Corn may be popped and passed around. Coffee making with a percolator always fascinates the spectator. A water heater will quickly start the water boiling so that it can be seen by all. Dainty fabrics should be ironed. A washing machine could be in operation. A Vacuum Cleaner should be a drawing card to the housekeepers.

An office demonstration of electrical appliances may be made specially interesting if held in the evening.

You could adopt the plan of asking dealers to furnish ornamental lighting fixtures and lamps for a lighting display to be made at the time of the demonstration.

This gives the dealer an opportunity of obtaining new business, encourages a more elaborate lighting system in houses and brilliantly illuminates your display.

If you have in your company or in your employ a man who can deliver a short address on correct and economical lighting plans for residences and who will discuss the history and theory of electricity as applied to cooking and heating appliances, it will help make the evening profitable for those who are present.

Music and a few flowers will help make the occasion noteworthy and the cost would be nominal. You will find that a demonstration of this kind will justify considerable space in the news columns of your local papers.

Terms of Sale.

The perpetual earning capacity of the Appliance Department is certainly sufficient to justify a lighting Company in occasionally giving it the benefit of the manager's personal attention. The routine work will of course be placed in charge of a man who may be called the Appliance Department Manager.

It has been proven that payments of one dollar down and one dollar a month on appliances will make it possible for every consumer to buy. Even people who have ample means will purchase more freely, knowing that they are obtaining the device at the right price and that it is seldom in business history that an article is sold on the installment plan without advancing the cost to the buyer.

These monthly payments will be handled through your collection department by attaching a separate bill to the meter statement, or as explained under the next heading.

The life of the heating elements will line up to the guarantee of any reputable manufacturer, so you are assuming no risk in making the most of this convincing selling point. In this connection it has been found that if the apparatus is treated with ordinary care the heating element will be in use at twice the guaranteed age. This is not a theoretical assertion, but is based upon actual experience covering a period of years.

The Ledger Account.

Some Central Stations carry the appliance or merchandise account on the same ledger folio with the current, others prefer two separate books.

Where the Loose Leaf System is adopted a smaller and lighter weight ledger sheet for appliances may be used and when placed in the binder it will always be found directly above the ledger sheet upon which the customer's current account appears.

The keeping of separate accounts permits of analysis in order that the true percentage of current and merchandise may be shown.

In billing, some companies prefer issuing a separate bill for appliance instalments, attaching it to the meter statement for collection.

Others contend that it should all be included in one bill, for the convenience of both the customer and the Company's bookkeeping department. It has also been noted that the customer is not then likely to make a payment of less than the full amount of the bill.

Employment of Salesmen.

Frequently young men working in the Central Station offices show a natural aptitude for salesmanship. Their services would double in value if they were taken from the desks. Men with ability for this work should be seized upon and developed.

College men usually have the personal appearance and mental training that specially qualifies them in selling appliances to the housewife.

Many young college men have taken up this line of work during vaca-

tions and have been so impressed with its possibilities that upon leaving school they have again entered the field.

High school boys of the present day can assume a manly attitude that pleases the lady at the door and she will frequently admit him for an appliance demonstration in her home when older men would be refused.

A foundation for the boy's interest in electrical appliances may be laid by donating two or three devices to the school Domestic Science Department.

This gift will redound to your benefit in more ways than one. It adds new interest to the teacher's work, consequently she will be appreciative. The pupils spread the news at home and parents are thus convinced that the day of electrical cooking has arrived.

The Y. M. C. A. employment bureaus sometimes have recent arrivals seeking positions.

There are many good salesmen in stores who are bent on finding an outlet for their ambition. Some of them would be glad to accept an offer from the Central Station for out-of-doors work.

Manufacturing Companies of heating apparatus may also be in a position to suggest the name of an experienced salesman who is open for employment.

Lighting and power companies have found that while an office display of electric appliances brings returns, a house to house canvass is much more effective. These two plans of selling should both be followed to obtain the best results.

In employing a solicitor it is important that he be fitted for the work. He must have a ready smile, be neat in personal appearance, and a man who specially enjoys winning his game.

Good men frequently object to canvassing but this distaste can be overcome if the facts are presented in the right light.

In the first place the lady at the door gives a cheerful greeting to a man who announces that he is employed by a company with which she already has business relations. This at once differentiates him from the ordinary solicitor. Again women are invariably interested in electric appliances as they are handsome, stand for cleanliness, and are time-savers. They represent modern methods, the very latest improvement in housekeeping conveniences.

The possibility is great of a salesman making more than ordinary wages. It is simply a matter of putting in full time and conscientious work.

Obtaining Results.

It is inadvisable to send a man out with more than one appliance at a time, but he should have with him cuts and prices on the complete line. After he has studied the literature and sales-talk furnished, his constant hammering on one appliance so familiarizes him with his "stock talk" that while giving it he can be studying his prospect. He will then be ever alert to seize the psychological moment for closing the sale.

Solicitors by occasionally changing the appliance will prevent their

work from becoming monotonous and will have an article of fresh interest to show the consumer when the next call is made.

You will find that the demand for coffee percolators, grills, toasters, etc., will be just as great as it has been for irons. Take, for instance, the coffee percolator; coffee is made at least once a day in nearly every household, indicating that every one is a possible buyer.

Furthermore, half the housewives have already expressed the wish that they had a good percolator. The many advantages of the electric pot over all others are so apparant that it doesn't require much time to convince a prospect. The electric iron has paved the way.

Now arises the question of price. We realize that in most cases it is necessary to make a special inducement in order to effect a sale at the door.

It is our opinion that an offer of "easy terms" is all that is required; a lighting company is so situated with reference to its consumer that it can extend credit without assuming any great risk. Ordinarily they have either a cash deposit or references and collectors are in constant touch with consumers.

The merchant is not so fortunately situated, nor can he put all of his profits back into advertising and selling and still come out ahead of the game.

We wish to urge upon lighting companies the desirability of maintaining good terms with the dealers.

There is no question that the dealer has his circle of friends and customers in a community who would prefer dealing with him. A word from him will frequently prevent many from buying and he is prone to "knock" when in competition with the lighting company.

It has been found that women discuss electrical appliances they have with their friends with great zest. This neighborhood discussion, coupled with liberal advertising, calls of solicitors and co-operation of dealers, will stir up a surprising demand.

Above all, weigh with care the merits of a line of appliances before placing them with consumers. Dissatisfaction kills the demand just as quickly as a meritorious article will build it up. Cheap goods will sell but there is an aftermath that will put your nerves on edge.

Liberal advertising will make heating appliances a household byword. Then salesmen will not have to spend time in convincing a prospect that they are offering a meritorious article. It is working along the lines of least resistance. There is a certain lighting company that has put out 8000 percolators and only 150 came back.

Compensation.

In the employment of salesmen it has been found advisable by some companies to place them under a small bond.

The reason for this is that the men collect considerable sums of money, both from those who do not wish to take advantage of the instalment plan and from those who make first payments.

It is wise to hold up the application for a bond for at least a week in

order to determine if the man is qualified for the position and if he is liable to stick.

The bond is paid for by the company, the charges being small.

If you follow the plan of making a monthly deduction from salaries to cover sick benefits and insurance, include these salesmen; make them feel that they are part of the regular office corps.

Numerous plans of payment for services rendered in selling appliances have been tried out. Some salesmen prefer being paid a liberal monthly salary and a small commission on sales. The advantages in favor of this system are:

Good men frequently hesitate at leaving the positions they have and start work on a commission basis. To them the plan is new and untried.

If a capable man works conscientiously with your consumers you are deriving a benefit other than that received from his direct sales. People may not be prepared to buy at the time they are approached, they may buy later at the company's office or they may close with the next salesman who calls, because of the efforts of the first man.

The fact of someone other than the unwelcome collector calling from your office, meeting the customers with a friendly smile and convincing them, if necessary, of your good will and responsibility as a guarantor, ties those consumers to you with a personal bond that you have not before enjoyed.

So we affirm that if your salesman at the end of the month has not made many sales and throws up his hands, you are not a loser and will eventually derive full benefit from his labor.

Another benefit in the larger monthly salary lies in the fact that men will at least give the position a month's fair trial.

In this, as in any other vocation, experience cannot be developed in a day and first efforts are frequently disheartening.

Under these circumstances, some men, if working on commission solely, will quit, whereas a few weeks' experience would have brought them out on top.

One more reason in favor of this plan is that salesmen will give more careful consideration and attention to orders from the office and will not be so frequently tempted to make misrepresentations in order to land a wavering prospect.

The considerations in favor of the large commission and small salary, or none, appear to be: More aggressive work on the part of some solicitors who set a mark, and the natural automatic adjustment of salaries to correspond with the abilities of the salesmen.

Commissions should not be paid until you are fairly certain that sales will stick; one week after delivery should at least elapse before payment is made. Returns, after commissions have been paid, must be deducted from later earnings.

Guard against abuse in taking back appliances. Some customers will use a heater during the spring and on a trivial complaint attempt to turn it in for a fan in the summer. Dealers avoid returns and still hold their customers; you can do likewise.

Don't be discouraged by frequent changes in your selling force. Keep

in mind the realization that every appliance you sell will for years to come be earning you that little old fifty cents a month.

It has been estimated by one of the large lighting companies of New York that six months' returns from a lighting contract is a fair expense allowance for securing new residence business.

Assuming that an average residence connection will bring in a revenue of $18.00 a year, which is low, then $9.00 would be the cost of obtaining the contract.

Upon that same basis an electric appliance will give a revenue of $6.00 a year and $3.00 would be a fair selling cost.

You will also remember that this selling cost on a large number of appliances on your lines is borne by the dealer. Add the profit you make on the sale of an appliance to $3.00, the amount you would be justified in paying, keeping constantly in mind the fact that this makes for a day-load, and you will realize that you can afford to pay a big salary to a big man.

Don't count the cost when you have your eye on a live salesman or the making of one, nab him on the spot.

Frequent Meetings.

Salesmen should frequently be called together for a comparison of ideas and experiences.

If regular meetings are insisted upon it will grow to be a matter of routine to which no objection will be raised.

That interest may be added to these meetings, have your men take turns in going through the form of selling appliances to one of their number who will offer the usual objections. It will sharpen up their wits. At the conclusion of the test invite criticisms.

In starting out new men load them up with literature and salestalks. It is not necessary that they repeat it parrot-like, but it gives a foundation, a starting point, upon which to build. Before they are permitted to go out see to it that they are examined and properly qualified.

If men spend time and thought in preparing for this work they will convince themselves that they have a good article and will not be so easily rebuffed.

If you think it best to first send them out with an experienced man see to it that you select one as an instructor who isn't inclined to "knock." Those who go out with new men should realize that when all of the men employed are doing a good business the department takes on an added importance. They will be more liberally helped with advertising and the manager will be more disposed to increase the commissions.

When Salesmen Grow Stale.

The time usually arrives with salesmen when they have the impression that they are past masters in the selling game. If orders are not coming in to your satisfaction these men promptly affirm that the trouble lies either with the appliance or the territory they are covering. As a matter of fact they may be growing stale in their selling methods.

The best plan to disabuse their minds of this impression is to call a series of meetings and invite travelling men or local salesmen, in other lines, to address them.

They will soon discover from these talks that there are many schemes for bringing about a sale that have never occurred to them.

The automobile salesman is always up against the keenest competition and has many a tough nut to crack.

He usually is willing to address these meetings as it gives him an opportunity of advertising the merits of his car with men who are in constant touch with the public.

Have your lighting and power contract men and office force attend these meetings. It will have a tendency to ginger them all up to a better efficiency.

When a salesman has not been successful in his district his failure may be due to a personality that doesn't please the class of people living in that locality. Try him somewhere else and he may do exceptionally well.

Encourage the men in studying literature describing competing appliances. If an opportunity offers have them examine their construction.

Do not hesitate over having them make frequent calls on the same consumer.

These people are finally impressed by your persistence and continued enthusiasm.

Under present business conditions trained men are displacing those who have but a superficial knowledge of their business.

The science of selling will always afford an interesting study and men who succeed will be greedy for knowledge that they can utilize in their work. Your best men will derive greater pleasure from achievement than they will from the size of their pay check.

A Preliminary Step.

If before a salesman is sent into a certain field, advertising matter is mailed to consumers, followed a few days later by a circular letter, it will greatly facilitate the efforts of your representative.

This letter should be sent a day or two before the solicitor calls.

Thousands of dollars are paid out by firms introducing specialties for mailing lists. A large percentage of the names they secure are not even possible purchasers.

The list you have is invaluable for this purpose and should be used to the limit.

Let your letter read something like this:

Dear Madam:

We sent you a few days ago circular matter describing our Electric Coffee Percolator.

We have tested from a practical and mechanical standpoint the various appliances of this character now on the market and unhesitatingly recommend this Percolator as being the most serviceable and economical coffee pot.

This selection was an important matter with us as we hope to have

you on our consumer's list for a number of years to come and we do not want any dissatisfaction to arise because of our recommendation.

One of our salesmen will call upon you shortly for the purpose of demonstrating this device and we ask that you give him a few moments of your time as we are making you a special offer that will be well worth your consideration.

Yours very respectfully,

Sales Women.

It has been found in some instances that women are more successful than men in selling appliances.

One of the best methods of operation for them is to make telephone appointments in advance. This plan gains immediate entrance to the house.

They having used gas and stove utensils will speak with the conviction that comes from experience when comparing them with electrical appliances.

A Salesman's Incentive.

The success or failure of your appliance department will depend largely upon the character of the salesmen you employ. Some good men may be obtained from other lines of employment if you make your offer sufficiently attractive.

Remember that there is a prejudice against house to house canvassing that you must overcome—make your call for salesmen, not solicitors or canvassers. We know of instances where appliance salesmen have drawn as high as $400 in commissions for a month's work, so the possibilities are there if you obtain the right man.

If you haven't time to present the offer to the man you have in view as it should be presented, give him a copy of the following letter.

We think it will appeal to young men who are in the rut and haven't had the nerve to get out and do things; men who are working ten hours a day for a pittance:

To Salesmen.

This letter is addressed more particularly to men who feel that if they had scope for their activity and ambition, they would accomplish things worth doing.

You will agree that the first requirement is forming a connection with a company well capitalized and likely to grow even in advance of the community in which you are living.

Once get your foot on a rung of the ladder and if you are made of the right stuff, you will climb and your objective point will always be worth while.

There is scarcely a department in a lighting company organization where more immediate notice is taken of a live, intelligent, responsible man than in the appliance department.

The reason for this is two-fold. The sale of anything other than electric current by companies of this character is not usual, consequently results are being watched by every one from the manager to the office boy.

Another reason is that, in the past so-called outside men in every branch of business have in many instances proven themselves unreliable.

This puts a premium on the man who is reliable and "makes good," and he will find it the most profitable, agreeable and independent work he has ever performed.

It is a well-known fact that out-of-door work will improve a man's health and his mentality to the point where he will accomplish all that is in him.

We want first to impress upon you the fact that calling upon a lighting company's residence consumers is quite different from the house to house canvassing for subscriptions or silver polish that you may have in mind.

The company's name will be found the open sesame to the homes of their patrons for business purposes and you will find the interest taken in electrical appliances will surprise you.

Remember, too, that we pave the way with literature and letters, so that you will be introduced and expected.

Men in the appliance department have found that after a week's experience, six hours of hard, conscientious work will bring in greater cash returns than men of equal ability are earning, though they have been employed for years in what they considered good positions.

The observing man will obtain unlimited knowledge and entertainment from his work.

He weighs his prospect's character, determines whether he will first have to create a stronger desire or concentrate on quality, or prove economical operation. Frequently the first step is getting on a friendly basis by a way foreign to electric appliances.

A man's wits are kept on keen edge and after a month's work in the field, he will find himself better prepared to cope with any situation in his personal affairs requiring prompt mental decision.

When you are working on a commission basis and a line of action makes a dollar or loses a dollar on the spot, you will analyze your methods as you never have before.

Right here, we want to say a word on salesmanship generally:

It is the key to success in every man's life. The doctor must sell his professioned services. Professional ethics may compel him to cover his tracks, but nevertheless his dress, his beard, his manner, his conversation, his social relations are all more or less determined by his idea of what makes the strongest pull for his services. And so with the attorney, and even the young man contemplating marriage will find the attractive Miss sought by others and every element of salesmanship will enter into his courtship though he doesn't realize it.

If, then, one's capabilities in this direction determine his future, why not get into a field where the highest degree of cultivation is possible; where your efforts stand or fall every half hour.

A good specialty salesman is in a position to demand the largest salary paid by business men. Big manufacturers are helpless without them.

The man who engages in this work will quickly discover that a smile will inevitably bring a reflected smile from his prospect and a kindly recep-

tion. Having this in mind, the good salesman fights off the feeling of grouchiness until it is foreign to his nature.

The advantage of this training over office or store work will be apparent when you consider that a man entering a store and asking for a particular article is an "easy mark" as compared with the one approached in his own office or home and there induced to purchase an article that he had not before desired.

Don't you see how much more instructive and interesting is the game under those circumstances? Go in with a determination to win; the returns financially will justify it.

Keep in Touch.

Always remember that a word of congratulation when justified and a reasonable criticism when deserved, will do more toward holding salesmen than will a raise in salary.

This is particularly applicable to outside men. They are working under high pressure and need to be kept in mental balance.

The appliance manager who keeps in close daily touch with their work will greatly increase the output.

Sales Record.

The form on page 55 will be found useful in routing the salesmen in the field. It also supplies a complete record of appliances sold.

These forms should be printed on a lightweight index card of good quality. For convenient use they are filed by district in a cabinet.

If a salesman has occasion to use an alphabetical arrangement he can readily find the name he wants in your permanent records.

If you now have no arbitrary designation for districts a numerical classification will answer, the cards in each district also being numbered consecutively.

The names of the street or streets covered should be written at the tops of the cards and these with the consumers' names and addresses should be typewritten as constant usage on the streets tends toward making them illegible.

Index tabs showing streets or districts will be useful.

These cards are passed out to the salesmen each morning and upon them they enter not only sales made, but by using symbols they may indicate the preference of the prospective customer beneath the appliance wanted. An absolute promise to purchase when the next call is made should be carefully noted.

Care should be exercised in keeping the number of names given to each salesman down to a minimum consistent with thorough work. Salesmen are disposed to pick the easy ones and fail to give the more obstinate prospects the time they should have.

It is a good plan to furnish salesmen with a black cloth, stiff back, side open, book cover the size of these cards. By using a heavy paper clip the cards can be secured to the back cover thus preventing loss or defacement.

When one tenant moves, or another enters, change of name should be made on the cards.

If a number of salesmen are employed they should be kept on the same district. This facilitates delivery and enables the men to meet occasionally during the day for a comparison of notes. By this means, too, a friendly rivalry is fostered.

Office Display.

An attractive office display of electrical appliances will augment the sales in a way that will convince you it pays.

Place a table or counter, with steps on it, against a side wall. Cover it with black velveteen and upon this display your articles, being careful about keeping them fresh and bright. Beneath the table place cupboards for reserve stock. Have cords in light sockets ready to attach to the appliances you are showing.

Your display may be made more impressive by adding a wall case with glass doors.

The table "Show" will bring the best selling results, as many visitors are more likely to purchase when they can pick up an article and examine it without calling a salesman.

A neat demonstrating table should also be put in and at the time of month when consumers are calling in the greatest numbers to pay their bills, have a girl giving demonstrations of various apparatus. See to it that her selling arguments are just as sound as those used by the men and that she does her work in a pleasing manner. Also secure demonstrating appointments for her with cooking schools and women's clubs.

You will find that this display of appliances in your office will make it much more attractive to visitors and that the department will quickly gain your respect because of its earning capacity.

One method of advertising which results in bringing in business is to print descriptive matter and small cuts of devices on the backs of meter statements. They are certain to find the mark, and are usually kept on file by the consumer.

Newspaper advertising, particularly in the smaller cities, will help in making your demonstration and your soliciting campaign a subject of general comment among housewives. You can obtain from manufacturers cuts illustrating any of their appliances which you desire to feature.

Using a Social Function.

This plan, more particularly in small cities, should work out successfully.

Select ladies who have an extensive acquaintance in the neighborhood in which they reside, and induce them to invite as many as possible to attend lectures on electrical appliances, and demonstrations, at their homes.

Let it be distinctly understood that no sales are to be made at the time, nor are prices to be discussed.

This defines the occasion as a social gathering, and the discussion of the electrical branch of Domestic Science will be found an instructive means of entertainment.

The lady at whose house the demonstration is held should be presented with an appliance without charge. This will usually be found sufficient as an inducement for her to make the affair a success in point of attendance.

A twenty-minute talk may be easily prepared, covering the application of electricity as a source of heat for cooking.

The demonstration should be limited to one or two appliances, but the other devices should be so described as to whet the curiosity of those in attendance to the point that they will express a desire to see them. As an example, an interesting exhibition may be given with a chafing dish and a percolator. Some dainty dish may be prepared on the former and coffee may be served from the latter The idea then would be to describe other appliances in such glowing terms that every woman present would want to see them. This would give an excellent opportunity for other demonstrations.

The way is now opened for appointments at the various homes of those interested. These may be made at the time or later by telephone.

In some instances it might be advisable to promise the lady in whose house the demonstration was held, a small commission on resulting sales.

The same plan, when applied to churches and social clubs, has proven successful, the inducing commission going to the organization treasury.

Young college men are specially qualified for this class of salesmanship, and they will find it highly congenial work.

Elec-tricklings.

Make liberal use of the display cards furnished by manufacturers.

Salesmen should be posted on the relative merits of the various appliances on the market.

A display of appliances on a tea table always attracts attention and emphasizes the coziness of electric cooking.

Selling two appliances with but a single cord justifies a reduction of one dollar. This makes an apparent special price and results in the sale of more appliances.

A salesman without enthusiasm will not serve your purpose. He is like a lamp with a broken filament—appears all right until you try to electrify him. He will never light the way to success.

The Kansas Gas and Electric Company issued an attractive circular illustrating all of the electric appliances they handle.

The headlines read: "What ten cents' worth of electricity will do." Under each article was printed the statement of how long or how many times the appliance could be operated for ten cents.

In order that immediate orders might result, a coupon was attached which, upon being presented at the office, was good for fifty cents to apply, on the purchase price of any appliance shown.

Electric irons may be sent out on trial without much likelihood of

their being injured by thirty days' use. It has been the experience of central stations that not over one out of fifty will be returned.

Hotels and cafes of the better class afford an excellent field for salesmen. There is an opportunity to put over a specially large order and incidentally the placing of appliances in such public places makes effective advertising.

In the morning it delights guests to either prepare toast themselves or to watch a waiter do so at the serving table.

The coffee percolator is an ornament to any table and gives ample assurance that the coffee will be fresh and good.

Evenings the chafing dish adds much to the pleasure of the lunch.

"The Cave," a fashionable restaurant connected with one of the best hotels in New Orleans, has a great number of these appliances in use, and the proprietor is delighted with his venture into the electrical field.

Men who are out on house-wiring campaigns and who are seeking new business are in a position to and will sell many appliances. Point the way and pay them in addition to their regular work, and there will be no question about results.

The Southern California Edison Company, of Los Angeles, Cal., has 80,000 consumers and over 90,000 appliances in use on their lines, which conclusively shows what intelligent effort will accomplish in building a day-load.

The Little Rock Railway & Electric Company installs in the street cars a small receptacle for folders. These folders are devoted principally to well-selected jokes, but the electric iron or percolator talk is present, and passengers with ample time on their hands are certain to read every line.

While making demonstrations at the homes of consumers a handful of pennies will sometimes help in clinching the sale. At the conclusion of the demonstration hand the lady a penny. She will very naturally want to know the reason for such munificence. Simply inform her that the penny will pay for all the electricity used while demonstrating an electric toaster, and that there will be a credit left over to be applied on the cost of a future cooking operation.

Some salesmen have successfully used this penny plan in selling percolators. They carry coffee with them and serve the prospect with as good a cup of coffee as she has ever enjoyed, at a cost of less than one cent.

Forms for Office Use.

The following forms for use of the Appliance Department have given satisfaction where they have been put in service.

FORM A D 123

APPLIANCE REPAIR REPORT

LOS ANGELES, CAL.____________________191__

FOLLOWING APPLIANCES SENT TO REPAIR MAN THIS DATE.

NO	SIZE	DESCRIPTION	REMARKS

Appliance Repair Report is 5 in. by 8 in., printed in triplicate, three colors of stock, quarter bound and two sheets perforated. One copy goes to the book-keeper, one to the repair man and one remains in the book.

ORDER NO.________________

$ ____ Nº 9700

LOS ANGELES, CAL.________________191_

RECEIVED OF ________________________________

STREET______________________________

THE SUM OF______________________________DOLLARS

TO APPLY ON PURCHASE PRICE OF________________________
SOLD THIS DATE

TERMS____________ SOUTHERN CALIFORNIA EDISON CO

BALANCE TO BE PAID ____________________SALESMAN

Customer's Receipt, 3 in. by 7 in., printed in duplicate and quarter bound. This book is carried by the solicitor. The original is a receipt to the customer and the copy makes his permanent record.

Form [illegible]

DEMONSTRATOR'S DAILY REPORT Date

Name of Company ____

Address ____

Where held ____

Hours ____ A.M. to ____ P.M.

Appliance demonstrated ____

Number sold ____

Other appliances sold ____

Objections preventing sales ____

Complaints on appliances in use ____

New uses suggested for appliances ____

Stock on hand ____

Total number of visitors ____

Signed ____

TO RECEIVE LITERATURE

Name ____
Address ____
Appliance ____

Name ____
Address ____
Appliance ____

Name ____
Address ____
Appliance ____

Name ____
Address ____
Appliance ____

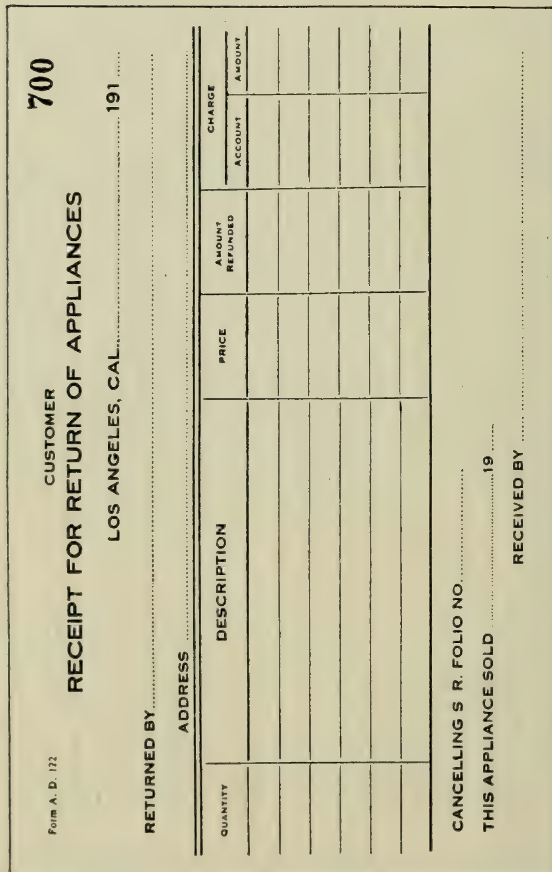
Name ____
Address ____
Appliance ____

Name ____
Address ____
Appliance ____

Name ____
Address ____
Appliance ____

Name ____
Address ____
Appliance ____

A report to be used by demonstrators may be printed on 5 in. by 8 in. flat stock, two sides. The prospects entered on the reverse side should be followed by the salesman. By these reports the efficiency of the demonstrator will be determined.



Form A. D. 122

CUSTOMER

RECEIPT FOR RETURN OF APPLIANCES

700

LOS ANGELES, CAL.......................191.....

RETURNED BY..

ADDRESS..

QUANTITY	DESCRIPTION	PRICE	AMOUNT REFUNDED	CHARGE	
				ACCOUNT	AMOUNT

CANCELLING S. R. FOLIO NO.....................

THIS APPLIANCE SOLD..............................19.....

RECEIVED BY..

Customer's Receipt for Returned Appliances is in triplicate form, three colors, quarter bound. Size 4 in. by 6½ in. The original goes to the customer, one copy to the office and the other remains in the book.

APPLIANCE SALESMAN'S COMMISSION BILL

SOUTHERN CALIFORNIA EDISON CO.

To ____________________ *Dr*

Location ____________________

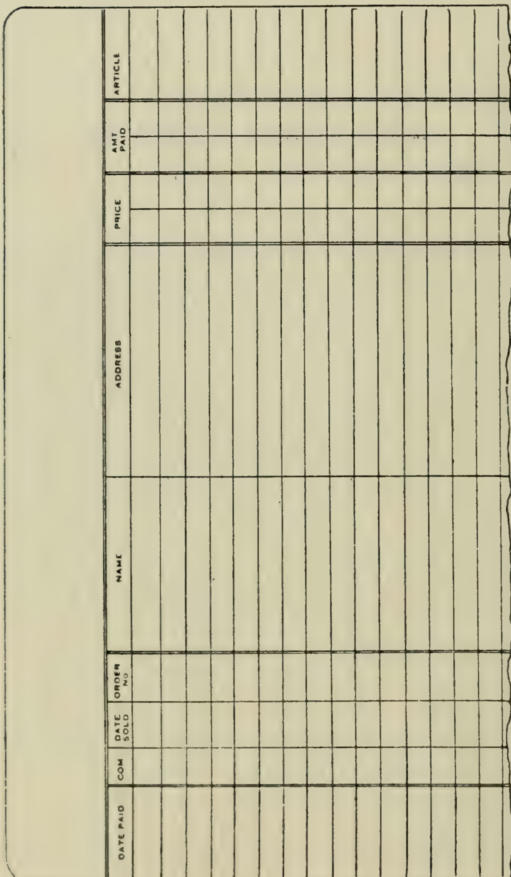
DATE SOLD	APPLIANCE	NAME OF CUSTOMER	AMOUNT	
			SALE	COMMISSION

Charge to Appliance Expense ____________________

Checked by __________ *Approved by* __________ AGENT

Received Payment __________ *191* __________

The above Appliance Salesman's Commission Bill is a sheet 6¼ in. by 10 in. and serves as an itemized receipt from the salesman to the Company. For convenience they are kept in pads of one hundred.



This Office Record is kept by the manager of the Appliance Department. Its dimensions are 9 in. by 14 in., and the sheet is bound in a loose-leaf ring binder. Each salesman is given a page under an alphabetical arrangement and returns are entered on the back of the same sheet.

Appliance Installation Record

Sec. 1 West 38th Street #1

NAME	Street No	Irons	Toaster	Percolator	Stove	Water Heater	Radiators	Heating Pad	Miscl.
Wilkinson H.A.	102	/		/					
Falconer T.F.	103	/		/			/		
Adams S.J.	104	/	/		/			/	
James Z.E.	105			/		/			
Johnson W.S.	106	/							
Willis E.G.	107	/	/		/				
Barton H.A.	108	//	/	/			/		
Ellis W.P.	109	/							
Marshall E.G.	110	/							
Anderson S.J.	111	/	/	/		/		/	
Newhall G.A.	112								
Crandall E.T.	113	/		/			/		
Montague S.A.	114	/	/		/				
Daniels A.F.	115	/							
McDowell P.O.	116	/						/	
Appleton H.N.	117								
Farwell J.M.	118	/	/	/		/			
Bates S.W.	119	/							
Allison W.E.	120	/		/					
Dalton Q. A.	121	/							
Holabird R.C.	122	/	/		/			/	
Spence A.L.	123								
Saunders T. W.	124	/		/					
Holton B.A.	125	/	/						
Andrews Henry	126	/							
Fenwick A.E.	127	/							

Appliance Installation Records, printed on index board 5 in. by 8 in.

Form A. D104

CUSTOMER'S COPY

APPLIANCE ORDER No. 6150

LOS ANGELES, CAL., ... 191.....

SOLD TO ....

ADDRESS ....

QUANTITY	SIZE	MAKE	ARTICLE	SERIAL NO.	PRICE	PAID	CHARGE

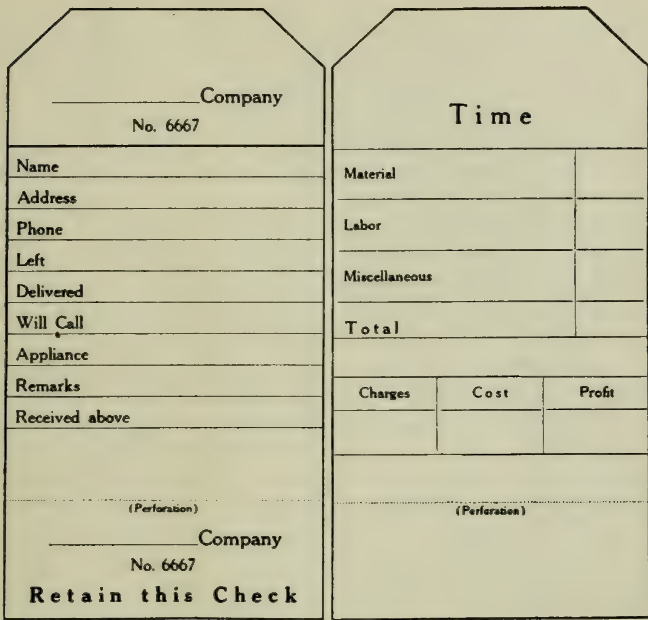
I acknowledge receipt of the above appliances, and agree to pay for the same as stated, and that title shall remain vested in the So. California Edison Co. until payment is completed. I further agree that the unpaid balance shall become due immediately in case I discontinue the use of the Company's Electric Service.

DELIVERED .... SIGN HERE ....

BY ....

SOUTHERN CALIFORNIA EDISON CO.

Appliance Orders are printed in quadruplicate 4 in. by 6½ in., four colors, quarter bound. These orders are written up by the salesman after they return to the office. One copy goes to the delivery department and customer, one to the bookkeeper, one to appliance manager and one remains in the book.



The form for the Appliance Repair Check is printed on a No. 8 shipping tag, the duplicate receipt number on the lower end of the tag is easily separated at the perforation. This check is given to the customer and the remainder of the tag is attached to the appliance to be repaired.

DISCUSSION.

The President: The paper is now open for discussion. Most of the members are no doubt deeply interested in the Electrical Appliance field, opening up business in the household line. We would be very glad to hear from any members having any problems on which they desire enlightenment or who can throw new light on the question under consideration.

Mr. L. W. Pratt, Hamilton: I listened with a great deal of interest to Mr. Rowley's paper on Developing the Appliance business, and there is a point that has occurred to me that perhaps has not occurred to the author of the paper, and that is, that one of the greatest obstacles in developing the appliance load is, in the great majority of cases, the house in which the customer lives is not provided with outlets for using these appliances. And one of the greatest opportunities in developing that business would be to induce contractors and consumers when they are building their houses or wiring them to provide plenty of baseboard outlets. The N.E.L.A. publishes a very useful booklet entitled "The Electrical Equipment of the Home." It deals very thoroughly with the best methods of wiring houses and where outlets should be placed, and I certainly recommend everyone interested to procure a copy of that book, and to furnish them to those who are about to wire their houses.

Mr. Hicks: I would like to ask Mr. Rowley in regard to commissions on sales of appliamces, and what do you think about the idea of making the commissions on the watt consumption of the appliances. Has anything been worked out or any information obtained?

Mr. Rowley: I don't believe we have any record of a scheme worked out on that basis of your current consumption on each of the devices. Take on irons, there are several companies in the States that allow a dollar commission on every iron that sticks.

Mr. A. A. Dion, Ottawa Electric Company, Ottawa: I do not pretend to be anykind of an expert on the sale of appliances, but I think this is a paper too good to be passed without considerable discussion. It is a very thorough paper, and it covers a great deal of ground, not only the selling of appliances but the treatment of those soliciting, etc.

On a recent date I attended the Annual Convention of the N.E.L.A. at Chicago with some other members of our company's staff, and on the way back from Chicago we compared notes, and I asked what was the greatest lesson that had been learned at the meeting. And we all agreed, in the end, that while we had found that in the matter of production and distribution we had not a great deal to learn—that is, we found we were very up-to-date in our methods, engineering and technical methods—that the greatest lesson we had learned was that we were lacking in energy and initiative in the way of pushing business, which includes the sale of appliances. I think this can be applied to nearly every company in Canada, not alone the one I am connected with. If there is any one department we want to brush up and improve it is the soliciting department, the sale of the current and the sale of appliances. We must adopt more aggressive methods to increase our sales. There was a great deal of valuable information on that point given at that meeting. And the members who did not attend that meeting but get the proceedings of the N.E.L.A. would do well to read them very carefully.

This paper is very valuable in itself, it contains a great deal of good advice and we must take it to heart and study it and see how we can apply the various counsels given there in our own business. There is one thing that is necessary, I think, for the success of the Sales Department, and that is thorough co-operation between the different elements that compose it. You have advertising, newspaper advertising, you have sending out of advertising matter in the bills, you have the window display, which is in itself a very big advertisement, and you have the demonstrations and the solicitors. There ought to be thorough co-operation between all these branches so that they may all work in the same direction at the same time. And also, it seems to me, that we must feature our advertising; not advertise and demonstrate in a promiscuous way all sorts of things, but separate the things and deal with only one thing at one time. The day when a man used to fill his advertising space in the newspapers with a long list of things he had in the store, and the day when he used to fill his show windows with as many samples of things he had to sell that he could crowd in, has, I think, passed. We all recognize now that to get results we must use our advertising space to advertise practically just one thing at a time. And the same thing applies to show windows. Now, if you decide on pushing a certain article during

a certain time, say one week or two weeks, you should advertise in the newspapers that particular article; your show window should contain nothing but that particular article; your demonstrations inside should be along the same line and your solicitors should push the same article so that you may get the cumulative results. The next campaign is for something else and you follow the same course. This is something that is worth considering and something likely, I think, to bring very good results.

Mr. Magalhaes, Toronto Electric Light Company: Right along the line of Mr. Dion's talk, in the office of the Toronto Electric Light Company there are three bulletin boards—one in the salesmen's room, one in the general offices and one in the telephone booth, and on those bulletin boards are placed the ads. which appear for that day—so that the salesmen know what is being advertised, the demonstrators in the demonstration room know, and also the telephone girls. They know not only what articles are being advertised but what special inducement is being given on that particular day. That brings the several departments together.

The President: If there is no further discussion we will now proceed with the next paper.

I have much pleasure in extending a vote of thanks to Mr. Rowley for his able paper on electrical appliances.

The next paper on the programme is "The Hydro-Electric Rules and Regulations and the National Electric Code," by H. F. Strickland, Hydro-Electric Commission of Ontario.

THE HYDRO-ELECTRIC RULES AND REGULATIONS AND THE NATIONAL ELECTRIC CODE

By H. F. Strickland

Hydro-Electric Power Commission of Ontario

Most people in the electrical business are more or less familiar with the National Electric Code which has been the standard of electrical installation work both in Canada and the States for some years.

The National Code has been adopted by every municipality in Canada and the States as the basis of their regulations.

The Hydro-Electric Power Commission, however, deemed it advisable to investigate the merits of every available practice here and in Europe, in order to satisfy themselves as to the very best rules and regulations obtainable.

In writing or adopting rules and regulations it is a very difficult task to frame them in such a way as to render them sufficiently flexible, and, at the same time practicable; especially is this the case with new regulations, as it is not desirable to introduce drastic changes which might inflict serious loss upon manufacturers and the dealers in electrical supplies.

The National Electric Code has, in conjunction with its Underwriters' Laboratories, kept in close touch with the manufacturers of electrical fittings and material, so that it has been a difficult matter for doubtful or unsatisfactory material to be marketed. The Underwriters' Laboratories in Chicago enjoy an enviable reputation in the United States for absolute fairness, and their approval of materials is accepted without question by all underwriting bodies as well as by all Municipal Electrical Inspection Departments in the States and Canada, and being personally acquainted not only with the personnel of the Laboratories but having thoroughly investigated and had dealings with them continuously for a period of over eight years, I have no hesitation in stating that their reputation is well founded.

The National Electric Code has furnished the bulk of the rules of the new Hydro Regulations now before us, because it has been found after careful consideration that the adoption of such of the Code rules as have been selected is in every way appropriate at the present time.

It will be noticed, however, that the arrangement of the Code is somewhat complicated, and embodies, in a general way, rules covering every conceivable form of wiring, inside and out. There are a lot of recommendations, many "shoulds," frequent repetitions, and an equal or even greater variety of cross references.

In editing the Hydro Regulations the rules have, as far as possible, been put under proper classifications, and very few repetitions or cross references occur.

The general rules as now in the Code are practically unaltered, so that the manufacturers and dealers in electrical supplies will not be adversely affected.

The Hydro Rules contain practically no "shoulds" but are positive in nearly every ruling, which if enforced as intended, should place the electrical inspection work of Ontario in the front row.

Nowhere on this continent is there a State inspection similar to that now proposed, although there are numerous civic inspection systems, many such in the United States and a considerable number in Canada, but in each case they are isolated, and there is more or less difference in the interpretation of the same rules; for instance, the inspection in the city of Winnipeg, which is carried out under the rules of the National Electrical Code, may differ considerably from that in the city of Halifax which has adopted the same rules. This diversity of interpretation makes it a very difficult matter where contractors are called upon to execute work in cities where they have not been accustomed to do business, as compliance with the rules in each separate Inspection Department is often affected by the personality of the Inspectors in such districts.

The Hydro-Electric Power Commission's system of inspection promises without reservation to be the very best method which has been devised in any territory of similar magnitude. Under the Power Commission Act, every Municipality in this Province must provide a sufficient and proper number of inspectors to enforce the rules adopted, and, owing to the fact that all disputes as to interpretation must be referred to the Commission for final adjustment, there will be such uniformity as will be not only of advantage to the general public but will, undoubtedly, be a great source of satisfaction to all those engaged in the electrical business.

The Hydro Rules and Regulations, as now before the public, have not been drafted with the idea of covering every conceivable form of construction, large and small, as has been attempted in the National Code.

It is hardly necessary to have a special set of rules governing the installation of such works as large central stations, sub-stations and similar undertakings which are invariably installed under the supervision of competent engineers. Such installations will be treated on their own merits. The set of rules now before us is drafted for the purpose of covering all such general inside wiring as will be met with in every-day practice and which anyone is liable to be called upon to perform. While a large percentage of the rules is an adaptation of the National Electric Code, it has been a very difficult task to re-classify them, and in many cases, re-word them in order to avoid the cross-reference and repetitions now so evident in that Code. In addition to this it has been found necessary to introduce a great many new rules and to enlarge many of the Code Rules to make them more comprehensive and complete. I will take a few concrete examples by way of illustration. In the first place, the new Regulations open up with some five pages of preface; this preface explains the nature of the legislation and the interpretation thereof in order to convey to the contractor and others interested such necessary information as will enable them to comprehend the scope of the rules in question and the interpretation which will be placed upon them. This preface takes the place of some short in-

troductory matter now in the Code, which latter is after all but a suggestion. Turning to page five we find a section covering "Switchboards," which contains some five pages of comprehensive rules as against less than one page in the Code, and in addition to this it is necessary to refer to other places in the Code to obtain all the data which affect "Switchboards." On pages eleven and twelve are found rules on transformers, and it is hardly necessary to look elsewhere for rules on this subject, whereas, transformers are alluded to in the Code in some four or five different places. On page twenty-one almost every point in connection with cut-outs, switches and circuit-breakers is to be found under the heading of "Controlling and Protecting Apparatus." The same general classification will be found to occur throughout the book. On page forty-six we come to an entirely new section not found in the Code at all, known as "Services and Service Meters," containing much valuable information and rules covering almost all the most essential features in connection with such work.

As an illustration of the enlargement of some of the Code rules, I would point out that on page forty-eight, reading as follows: "For low potential systems the service wires may be brought into buildings through a single iron conduit, the conduit to be equipped with an approved service head." In the National Code this is all that is said about such work, whereas, by reference to Hydro Rules you will find that this rule is extended throughout the next four or five pages covering practically every detail in connection with such work.

Prominent among the new rules not found in the National Code are those necessary for the protection of life. From some of the finished rules bearing on this feature, I will cite the following: "Under 'Generators' and 'Motors' the grounding of frames is called for where the potential exceeds 300 volts." Similar new introductions are found under "Switchboards" and "Electric Cranes." Under "Installation Work" on page forty-five, such rules as "k" and "l" are intended to reduce danger, neither of which appear in the Code at all. In a word, in various places, rules have been introduced which are calculated to protect unskilled persons and those who are liable to inadvertently come in contact with live parts, from receiving injurious electric shocks. It is, of course, impossible to make any source of energy, attended with danger, absolutely foolproof without placing such restrictions around it that its use would be impracticable and onerous, and the best that can be accomplished is to so reduce such danger that it will be safe to use electricity in its various forms.

Up to the present time there has been no legislation of any kind in this Province bearing upon the introduction or use of electricity, with the result that anyone, skilled or unskilled, could install electrical apparatus in any way he pleased, and so long as the lights burned and the wheels turned, it was regarded by the consumer or purchaser as evidence of a satisfactory job.

It is true that the Fire Underwriters have, through their influence, been able to prevent a good deal of loss, chiefly from fire, but where they have no insurance at stake they are powerless to do anything. Municipalities throughout the Province have been, and are to-day, operating plants with old transformers, with ungrounded secondaries, and we all know that

it has caused the loss of many valuable lives. The loss from fire from defective wiring has, undoubtedly, been a serious item, and I am firmly convinced that many of the serious fires throughout small towns of this Province have started from defective wiring. It is a common sight to see such wiring in large hotels and stores throughout this Province which is just inviting disaster. I have been in places where the electric current is never shut off from dusk until daylight, where large stores are left at night with lights burning and all wires alive. It is a common sight to see these wires protected (?) by fuses which would allow the wires themselves to melt before the fuses; to see open fuses in dangerous proximity to highly inflammable material, the bulbs of lamps lying on inflammable goods, draperies pinned to flexible cords in show windows, wires lying on gaspipes in the basements of stores and hotels, old frayed flexible cords hanging around in dangerous proximity to inflammable material and often not protected by fuses, circuits overloaded, five, six and even ten times above the proper limit; bare joints in wooden moulding, loose connections under switch terminals and a multitude of other kindred and dangerous defects.

To the uninitiated mind these defects do not convey any idea of serious consequence, but to those who understand, it is only necessary to mention them to show the need of proper control and supervision of electric wiring and the installation of apparatus.

We do not claim that our book of rules is a finality on this subject but we think that they are the best start which can be made, and they will be revised as circumstances warrant it, and I am sure that it is the Commission's desire and intention to keep thoroughly abreast of the times and keep this book of regulations well in touch with the best current practice, and not only to affect a great improvement in the conditions referred to but to secure the co-operation of all those who are called upon to execute electrical work.

In reading this paper it is not my wish to convey to anyone that the use of electricity is highly dangerous. We in the electrical profession know that electricity is conceded to be the safest illuminant and form of power known, and in concluding I would draw attention to this fact in order that the general public may know that while it is necessary to prescribe rules and regulations it is not intended to prejudice the lay mind against the use of electricity in any form. On the contrary, we all know that under a proper system of inspection and regulation it is the safest and most convenient agent for the purpose.

In conclusion, I would point out that I have endeavored to give an outline of the Hydro Rules in a short space and hope that they will be received favorably by those present who, I trust, will realize that it is a difficult matter to present a thorough and comprehensive digest of the entire situation in a few minutes. If, however, there are any points on which I have failed to touch, I shall be pleased to explain them to the best of my ability.

DISCUSSION.

The President: We all know that Mr. Strickland has been very closely identified with the inspection of electrical installations for a number of years in Ontario, and there is no one better qualified than Mr. Strickland

to give a paper on this question. It is one which should open up a wide discussion.

Mr. S. B. Hood, Toronto Electric Light Co.: Some months ago a committee, representing the Toronto Section of the A.I.E.E., was called together to discuss the proposed rules of the Hydro-Electric Commission. This committee was composed of men whose technical training made them thoroughly familiar with wiring and apparatus as covered by the proposed rules. The objections then raised to the rules, as then proposed, were so extensive that the Commission agreed to revise them and again submit them to the committee for reconsideration.

The revision has apparently been made in some cases, but, as far as I, a member of the committee, know, they have never been re-submitted, and apparently the Institute has been ignored in the adoption of the final draft. This would appear to be a breach of good faith, and one which certainly should have the consideration of this Association, being so closely allied in its interests to that of the Institute. If our representative electrical bodies are to be ignored in the matter of formulation and adoption of rules in which they are so vitally interested, they can hardly be expected to show any very enthusiastic co-operative spirit.

The principal objection which is, and must always be, raised against these rules, irrespective of their fairness, or apparent fairness, is that their interpretation is in the hands of the most interested party. In the case of a city or district served by competing municipal and private companies, the chances for unfair discrimination are so self-evident that the fairest interpretation in the world must always be open to question. The fact that an appeal can be made to the Commission as a final resort is somewhat ludicrous, in that the court of appeal will, in most cases, be a joint partner with the municipality operating the inspection bureau. This point is brought to the attention of your Association merely to show in advance one of the difficulties our esteemed friends are going to run up against.

Generally speaking, the rules, as now issued, are a credit to the men who have gotten them out, and closely follow those of the National Code, including the profuse explanatory notes which were so prominent in the old Code of some years back. These notes will, no doubt, be of immense value to the novice who is engaged in interior wiring so generally, and will also serve as a reminder to many of us who have been at the mill so long that we may have forgotten some of the points so carefully brought out.

There are two excellent rules embodied in this book: *First*, neutrals must be grounded; and, *second*, fuses must be omitted from these neutrals. This shows that the Commission have recognized the dangers of the omission of the first item and insertion of the second.

Unfortunately, however, they have stopped just too soon to make a good job of it. Having provided for keeping the neutral closed, and realizing the danger of its being opened, they tell us, in the third paragraph on page 2, that we must insert the generator protection in the grounded leg; and, again, on page 26, rule *j*, they specify a switch in every leg of the circuit. If it is dangerous to open a neutral with a fuse, why is it not equally dangerous to do the identically same thing at the switch?

Again, in rule *g*, page 24, the same neutral that is required to be made solid in the three-wire line must be fused, simply because one of the outers is dropped off the circuit and the balance of the same circuit carried on to the utilization point. Why, in common sense, can we not be allowed to kill two birds with one stone, and make our system both cheap and of the utmost safety by using a solid common neutral supplying every utilization outlet? If we were allowed to do this, it would be but one step further to reach the ultimate point of cheapness and safety by making this neutral of bare conductor, heat insulated only from its supports. It is a regrettable feature of both these rules and our old friend, the National Code, that their makers (like all large bodies) move slowly. It has taken over ten years to get our neutrals grounded and get rid of the neutral fuse, and will probably take ten more before we will be allowed to use a common-grounded neutral to the same extent that has permitted the electric railway interests to operate their ground return system with the utmost simplicity, safety and reliability from its inception.

On page 113, rule 2, section *b*, is interesting in that a two-wire circuit must be grounded up to 150 volts, but a three-wire system must be grounded with the sky the limit. This is no oversight, as shown by rule *h* on page 115, where over 150 volts may be grounded by special permission, with particular attention called to the fact that this does not apply to former rule *b*. This point is mentioned as a discrepancy, and not as a criticism, as I firmly believe in grounding the neutral of every circuit irrespective of its voltage. On page 52, section *h*, the requirement of 2,500-volt insulation on all service conduit leads over 150 volts is going to prove very detrimental to the use of three-wire, 115-230 volt services. Similar discrimination is shown in the matter of meter and service equipments on page 57, rule *n*, where metal-enclosed switches and cutouts are necessary on a three-wire service. This requirement should certainly not have been applied up to 300 volts, which would have covered all ordinary lighting services and given a factor of safety of 400% on standard 600-volt wire. The service illustrations of figures 18 and 21 have apparently been designed with the understanding that electricity is now so cheap in Ontario that no one but a fool would take the trouble to steal it. Rule *a*, page 46, evidently has this in mind also, where it requires the switch to cut off current from everything, *including meters*. The Central Station must have control of the supply up to the meter and must maintain current on the meter at all times. Ample protection for the meter is provided by the sealed service fuse, and no exposed live contacts can be permitted on wires or apparatus carrying unmetered energy. Hundreds of thousands of dollars have been expended in the past few years in the development and installation of sealed service equipments, all designed with the switch AFTER THE METER. The largest company in the States turning out this line of fittings (and now operating a factory in Canada) has for its engineer the manager of the largest Central Station company in the world, whose experience along this line is beyond dispute. It will be interesting to watch the effect of the enforcement of this rule, which means the confiscation of practically every dollar's worth of apparatus now developed and used in direct contradiction to the rule. The National Code ruling of similar wording is now practically obsolete, owing to the

opposition from the Class A members of the N.E.L.A., and I imagine the Ontario Commission's engineers may look for squalls ahead.

Another point, which has been recalled to my attention by listening to the paper on electric heating devices, is the adoption of the old Code rule of 660 watts and a six-ampere fuse for branch circuits.

The rigid enforcement of this rule would have a serious effect on the use of appliances designed for attachment to ordinary lamp socket outlets. In practice the usual result of trying to enforce this impractical rule is the ultimate substitution of copper cents, or other make-shifts, for the original fuse which would not carry the load.

It is past me to understand why, when we are limited to a minimum size of wire which is rated and approved for fifteen amperes, we are not permitted to fuse this wire to over six amperes, or less than one-half its safe carrying capacity.

The President: We would like to have more information on this subject, and Mr. Strickland can then have an opportunity of answering the queries and criticisms.

Mr. Pratt: I think electrical inspection is something that everyone has had something to contend with.

Mr C. U. Peeling, Bowmanville: In regard to the grounding of transformer secondaries, I do not believe that there are any specifications given in regard to how that should be done. It seems to me that is the most important part of the grounding. If you do not ground them properly you had better not ground them at all.

Mr. Strickland: I was very much interested in Mr. Hood's attack on our methods and rules. I do not think he really meant they were quite as bad as one would think from the way he put it, because we did not commit a breach of faith at all. The rules were submitted to the Engineers' Section, and the last word was that we would have them revised in accordance with the National Code. Now, they were re-submitted at the Parliament Buildings, at a large meeting there at which, I understand, the Engineers' Club was represented. I know we had a letter from the Secretary of the Committee.

Now, I cannot pretend to answer Mr. Hood's criticisms all off here on the floor, because they were read off quickly and they were typewritten. It is quite evident he has spent a good deal of time in getting this up, and it would be very hard for anybody to get up and answer them all off at a moment's notice.

I can only say this much, that the rules and regulations have not yet been enforced, although the City of Ottawa has been the first city in Ontario to make a move, and has appointed an inspector, and we will see if there is anything the matter with these rules when we do start to enforce them. Now, you can take it from me that the Commission are not going to impose any rules or regulations on this Province that are not going to be satisfactory to the majority of the people. They are not going to make rules with the intention of putting Mr. Hood's company out of business either. Further, the question of these rules is one which will require gentle and careful enforcement at first, to see where there may be any weak spots. The man who gets up here or anywhere else and says

he can write rules that are absolutely beyond criticism is a fool, because he cannot do it, and I do not for one moment pretend to say so; it is a large question, and a lot of time has been given to it, and I am quite satisfied that if there are little discrepancies here and there they can be very easily remedied. I do not believe there is a work got up on any subject which is perfect at first. While I appreciate Mr. Hood's criticisms very much indeed, I should like to have his typewritten remarks to reply to, and I could then reply to them in writing. That is the only way I could give proper answers to them. (Applause.)

Of course these rules are not a work or a technical book on how to do wiring. No set of regulations was ever got up with that intention. The only thing we can do is to give as much as possible of the general requirements. Now, when we say "permanently and effectively grounded," I think that is quite sufficient. We may adopt at some time some simple explanatory note to add to them. We are getting up another edition of this book, the first being about exhausted, and if there is anybody here that cares to send in any suggestions along the lines of explanatory notes in the way of "grounding," we will be pleased to have it, and they will be carefully considered. We feel two heads are better than one, and many people have ideas they might send in and we are only too glad to have them, and if we can add any satisfactory explanations when re-writing the book in question, we will be only too glad to do so. I hardly think it is the intention that any set of regulations should be, or is, in any place a complete treatise on how every detail of work should be carried out. We give the minimum requirements here of what is safety to life and property and we will try and see that the inspectors throughout the Province enforce these rules with a little horse sense. (Applause.)

When this book has been longer in use I will be able to find things in it better; I am used to the National Code and I could tell you what is in it and what is not. This book is a new tool in my hands. I know pretty nearly what is in it, but I am under the impression, without looking at it, that there is a section in there on grounding. Grounding to water pipe we consider the best.

A Delegate: Your index gives grounding.

Mr. A. A. Dion, Ottawa: Suppose a case where the company has been in the habit of grounding on water pipes with the permission of the City Engineer, and there is a change and a new engineer comes on the scene, and says you cannot ground on the water pipes, because of electrolysis and other reasons, and you cannot convince him that he is wrong as to the electrolysis, for instance, and you find that his men are cuting off ground wires where they come across them—what is the effect of the new rules, since they are promulgated by legislative authority covering the whole province? Would it have the effect of forcing the municipality to allow you to use the water pipes or will the municipality have individual freedom in the matter? If this rule is to be enforced strictly, it seems to me it should apply to the municipalities, and compel them to use and allow others to use the water pipes.

Mr. Strickland: There is possibly one point here that I don't think you understand, and perhaps it is not generally understood, that the Hydro-

Electric Commission are not going to do the inspecting. That is one point I am going to tell Mr. Hood—we are not going to do the inspecting. The inspecting is to be done by the municipalities. The Act says that the Hydro-Electric Commission may make rules and regulations, which are these, and that the cities will be required to appoint inspectors to enforce them. We will supervise these inspectors, organize their departments, interpreting the rules to them, and if there is a dispute between the inspector and the contractor in the town, it will come to us to be adjusted. That is all. Now, as the cities are doing the inspecting, I do not think there will be any difficulty in getting that water pipe question straightened out, because this Act gives us the power to make a regulation which would, I am sure, take precedence over a local city by-law or objection of a city engineer, and if it does not we will see that it does; that is all. (Hear, hear, and applause.)

Mr. J. A. Harris, Toronto Electric Light Co.: Going back to the point of the inspection, you say the Commission are not to do the inspecting, that the municipalities are to do the inspecting—it must be borne in mind that the municipalities are in the field for the supplying of electric current, and will the inspection be done by the electrical branch of the municipality, or will it be a separate inspection organization? That is the point that I think Mr. Hood was bringing out in his argument.

The President: I can appreciate Mr. Hood's point of view. It is the point of view of every operating company—whether the inspecting is to be done by an interested party. The proof of the pudding will be the eating thereof. We will have to see how Mr. Strickland and the Commission interpret these rules, whether they do discriminate against the companies. Personally, I do not think they would, but they are in a difficult and peculiar position themselves; that is the unfortunate part of the situation.

Mr. A. A. Dion: It means that the Hydro-Electric Commission has constituted itself a public service Commission, in a sense, along with the other features of its functions. That is the unfortunate thing. I think the regulation of such things should be entirely disassociated from the other functions of the Hydro-Electric Commission. I think it is an anomaly to have these several functions in that one body.

That is the position of practically every operating company. The Commission are directly interested, and more or less in competition. They are practically Judge, Jury and Complainant. Where any such body rendering the decision is brought more closely in touch with one of the opposing parties than the other, there would not be the same feeling of security, and there would be a tendency to feel that, in certain cases perhaps, the decision would have a tendency to be biassed, if not regardless of the interests of the opponents.

The President: I am sure we are very much gratified with Mr. Strickland's synopsis of the Hydro-Electric rules. Every member should take them to heart, and apply them where possible in the improvement of the service. One of the important points is the particular attention that is given to protection of life as well as property hazards. While this has had the closest attention of all operating companies and associations, it was

not formerly given the attention it deserved by the Fire Underwriters' Code. The N.E.L.A. have done a great work along this line, and I am glad to note that the Commission are giving this phase their closest attention. I think a good many of the difficulties that are anticipated will probably never crop up. That reminds me of a story of an old man, some 65 years of age. He said: "I have got to be an old man; I have had many troubles but most of them never happened." (Laughter.) We hope that will be the result in this case.

The next paper will be "Underground Distribution for Small Cities," by S. Bingham Hood, Toronto Electric Light Company.

UNDERGROUND DISTRIBUTION FOR SMALL CITIES

By S. Bingham Hood
Toronto Electric Light Company, Limited

During recent years, the development of civic pride has created a widespread demand for an improvement in the appearance of the streets of our cities and towns.

Unsightly overhead electrical construction has, without doubt, been a strong factor in leading this civic pride to the point of demanding, and insisting upon, the removal of this class of construction, and substituting a system of underground distribution.

In our larger cities the load density makes overhead construction, in the congested districts, a difficult and expensive proposition; consequently economic requirements and esthetic demands are very apt to become coincident factors, and underground construction is not a burden upon the operating company.

In the case of our smaller cities, however, the problem is vastly different. The load density, and corresponding income, do not warrant expensive underground distribution; consequently yielding to the demand for this class of distribution must inevitably place an additional burden upon the community as a whole, or at least that portion of the community who patronize the local distributing company.

Some of our municipally operated systems are handling this proposition by charging the cost as a local improvement against the abutting property owners. This idea is somewhat amusing in that the cry for "all wires underground" becomes very much subdued when those immediately affected find they must back up the demands by cold cash.

Unfortunately for the private company, they have no practical means of dealing with the matter in this way; consequently their only resource is to grin and bear it until such time as the growth of the business has increased the net revenue to a point where all its customers are paying an excess profit sufficient to cover the increased overhead cost due to underground construction used only to supply a few. In other words, underground construction means maintaining a rate for current which, with overhead distribution, could have been reduced without lowering the net revenue below the point where a fair return on the investment is earned.

In the vast majority of cases, the local company are themselves, to a considerable extent, responsible for the underground construction demand, in that they have maintained a class of overhead construction so slip-shod and unworkmanlike in appearance that it is a continual eye-sore to the public. Such construction, with present day standard fittings available at very moderate prices, is inexcusable; consequently a company which persists in offending by maintaining, and continuing to erect, a class of construction based on the old telegraph standard of thirty years ago, and looks as if it had actually been erected at about that time, deserves all it gets in the line of public criticism.

The writer had the pleasure of bringing to your attention last year a type of overhead construction which he believes comes as near eliminating

the unsightly appearance of distribution lines as possible, except by actually placing them underground; and will take great pleasure in showing any of your members interested actual examples of the type of construction then advocated, and now standardized in Toronto. This construction should prove particularly interesting in that it can be immediately compared to old types of construction in the vicinity, and to recently erected lines on what are claimed by competing engineers to be the last word in overhead distribution.

The object of this paper is to endeavor to outline a type of underground distribution which has been tried out successfully in this city for these locations where the demand for "underground" has been such that no form of overhead construction would have been acceptable.

We will not attempt to go into the whole problem of general underground distribution, but will confine ourselves to the problem which so many of you are now facing; namely, the elimination of poles and wires from the main streets of your city.

This problem permits of locating your transformers on poles located on intersecting streets and terminating your high tension lines on these poles. The problem then becomes one of low tension distribution only, which involves no complicated conditions and resolves itself into a matter of striking a balance between first cost and reliability.

In our larger cities we find the original Edison Iron Tube System still in extensive operation; but being gradually displaced by a conduit draw in system. Here we see the condition of accessibility being given first consideration in the design. With the load density found in these congested centres, requiring extensive networks of feeders as well as mains, the relative cost of cables as compared to the housing (conduit) system is high. Consequently the possible saving by using a solidly laid system over that of a draw-in system is not so important, and accessibility can be given preference over first cost. Table 1 gives the cost of conduit systems under

CLASS OF WORK.		COST IN DOLLARS PER FOOT									
		LABOR		CONDUIT		CONCRETE		REPAVING		TOTAL	
		DUCT	DITCH	DUCT	DITCH	DUCT	DITCH	DUCT	DITCH	DUCT	DITCH
SOLID SYSTEM	PAVED		.39						.30		.69
	UNPAVED		.22								.22
SINGLE DUCT	PAVED	.52	.52	.07	.07	.05	.05	.30	.30	.94	.94
	UNPAVED	.35	.35	.07	.07	.05	.05			.47	.47
3 DUCT	PAVED	.22	.66	.065	.195	.028	.085	.17	.52	.49	1.46
	UNPAVED	.16	.48	.065	.195	.028	.085			.25	.76
4 DUCT	PAVED	.16	.64	.06	.24	.025	.10	.105	.42	.35	1.40
	UNPAVED	.13	.52	.06	.24	.025	.10			.22	.88
6 DUCT	PAVED	.12	.72	.055	.33	.02	.12	.07	.42	.27	1.59
	UNPAVED	.09	.54	.055	.33	.02	.12			.18	.99
8 DUCT	PAVED	.10	.80	.06	.48	.016	.13	.05	.42	.24	1.83
	UNPAVED	.07	.56	.06	.48	.016	.13			.15	1.17
12 DUCT	PAVED	.07	.84	.055	.66	.012	.14	.045	.52	.18	2.16
	UNPAVED	.05	.60	.055	.66	.012	.14			.12	1.40
NOTE:- ABOVE PRICES EXCLUSIVE OF CABLE, MANHOLES OR HANDHOLES.											

- FIGURE 1 -

average conditions of city construction in sand or loam. By reference to this, and assuming that for a large city system an eight duct line is the average size we find a cost per duct foot of about 24 cents. A heavy feeder cable in this duct will cost about 80 cents, so that the duct system represents, excluding manholes, about 23 per cent. of the total cost.

Applying this to a small local low tension distributing system using a four duct line we find the cost per duct foot to be 35 cents, or $1.40 per ditch foot; to which we must add cost of a handhole about every 100 feet. This would bring the cost per ditch foot up to $1.65. The cable system for mains, using 250,000 C.M. lead outers and a 2/0 bare neutral would represent an investment of about 60 cents per ditch foot, or a total cost of $2.25 per foot of main; of which the conduit system represents over 70 per cent. This is the all-important problem for the engineer of the system in the smaller cities to solve; namely, is the accessibility feature worth increasing an already burdensome investment 70 per cent?

What could we save by laying our cables solid in the earth? By reference to the table and using the smallest size ditch, that suitable for a one duct line as being of the minimum width, and allowing 25 per cent. of the labor cost as representing that required to lay conduit with its concrete envelope, we get an approximate cost for a solid system as follows:

Labor, per ditch foot	$ .39
Repaving " "	.30
Cables	.60
Cover Board	.03
Total	$1.32

This represents a saving over a conduit draw-in system of 93 cents per ditch foot, or over 40 per cent. Assuming that we can look reasonably well into the future as to load demands, which we usually can do in the case of substituting underground for overhead distribution in a small city, the main street of which has fairly well reached its final development, it looks as if this saving should be utilized if possible.

Lead cables laid solid in the earth are not subject to any deterioration other than mechanical injury, excepting what would exist if pulled into a draw-in system. For years and years past it has been common practice to lay lead pipe water services directly in the earth. Such services are maintained under identically the same conditions as a solidly laid lead cable system, and subject to the same chances as to chemical and mechanical injury. In addition they have the freezing element to deal with, particularly in our climate. Have the water works engineers found it necessary to lay conduits or other protective structures for these services, in order to give protection against mechanical injury or to provide for accessibility? Most assuredly they have not; therefore, why should we?

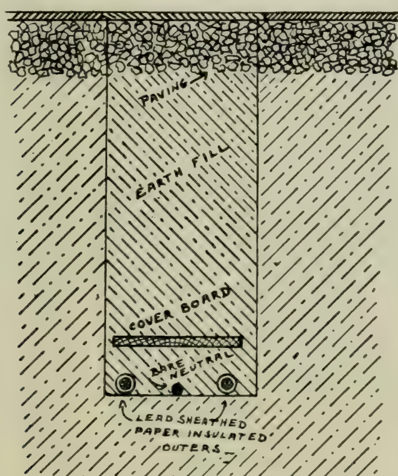
In England, the solid system of mains is almost universal practice and, at double our standard distribution voltage, is giving every satisfaction, and making it commercially practical to maintain an extensive underground network on load densities which would stagger the engineer of any of our

smaller companies who might be called upon to face a complete underground proposition for his district.

The use of three core armored cables is the practice there, but this type of cable does not appeal to the writer for application to our conditions for the following reasons:

First—The jute protection over the armor and between the armor and the lead sheath is bound to depreciate sooner or later, due to chemical action or mechanical injury. This leaves two dissimilar metals in close proximity in a chemically charged soil. Injury to one or the other, or both, is bound to follow.

Second—In the event of the earthing of the neutral and one outer, and alternating current being used, the armored sheath will cause an inductive drop which will prevent the other outer being continued in service and may cause heating which would ruin the entire cable.



- FIGURE 2 -

Third—The advantage of continuing in operation one side of a three wire system, when the other is in trouble, is of considerable value as effecting continuity of service. This is not possible with a three conductor cable and single conductor armored cables can not be used with heavy alternating currents.

With the use of a solidly earthed neutral this conductor can be laid with bare copper, being simply in the form of a bond wire around the various earthing points located one at each customer's service.

We therefore require but two insulated and lead sheathed single conductor cables for a three wire system. The combined cost of these and the bare neutral will not exceed the cost of a three core armored cable, and we have all the advantages of two independent two wire systems as to reliability

and continuity of service. In laying these cables, about four inches of earth should separate each conductor from the bare neutral, or about eight inches between the outers. The group of cables so separated should then be covered with from four to six inches of earth and a cover board of one inch rough lumber, carbolinium treated, laid down and ditch filled in. This gives a system of the utmost simplicity and one which any unskilled laborer can successfully lay with proper supervision. Figure 2 gives a cross section of such a system and illustrates clearly its simplicity.

Now as to mechanical injury, which is the only one we have to deal with, as electrical injury with a solid grounded neutral and the most ordinary care in laying and jointing is practically eliminated with modern cable purchased under standard specifications from reliable manufacturers, on 600 volt rating.

Mechanical injury can occur in but one way—digging a hole down through the street surface to the cables. Anyone making such an excavation first hits the cover board, which not only requires considerable force to break through, but serves as a warning to almost anyone whose work makes him familiar with underground conditions along a city street.

Allowing that an unusual absence of brains does finally permit of getting through the cover board and down to the cables. The worst that can happen is a punctured cable which, in the ordinary small system, will blow the fuse, and resulting complaints would naturally lead to an investigation, which, with ordinary prompt attention, will catch the culprit before he has his ditch filled in. Repairs can then be made by stripping back the lead, re-insulating, and putting on a patch or split sleeve; or, better still, a split box which can be clamped around the cable and filled with compound. Now the chances of anyone cutting into the second cable after damaging the first are so slim as to be almost negligible.

In the event of the puncture not blowing the fuses, the lead covering will burn away until it clears itself, in which case the ditch will probably be filled in and the damaged cable buried without repairs. This looks serious at first sight, but, as a matter of fact, would only result in a small leakage which, of course, should be repaired if possible, but would not interfere with operation of the system if left in the damaged condition. To illustrate the trifling leakage which would occur in a case of this kind just consider the common driven pipe ground connection which so many of us have endeavored to use for neutral grounds on our system, and have found practically useless for this purpose. Here we have a length of pipe probably eight feet long and three-quarters of an inch in diameter, with a contact surface of over one square foot. Under the most favorable conditions such a ground will not pass more than ten amperes at 110 volts and under average conditions probably not over two amperes. Now compare this area with the area of a cable core which would be exposed by being cut into by a pick or shovel and it is at once plain that we would almost require a milli-ammeter to detect the actual leakage current.

If we consider the unusual classes of injury, such as driving a bar through the street surface for attachment of derrick cables, blasting operations for deep sewer excavations, undermining for sidewalk vaults, earthquakes, and

a thousand and one similar conditions which are in most cases improbable, the solid system will stand up better than a conduit draw-in construction. This is because the disturbance of a conduit line introduces a shearing action on the cables, while, in the solid system, the cables will give with each movement of the surrounding earth.

Now let us consider two other causes for damage to underground cables; namely, electrolysis and gas explosions. The first of these is due to stray railway return currents leaving the cable sheaths at definite points. In a conduit system these points usually occur at the hangers in manholes and where the cables are in contact with points in the duct line, as where cables touch the edge of ducts in bending around manholes and at joints in conduit where the cement has squeezed through and formed a little projection which is always more impregnated with moisture than other parts of the conduit. The old practice of preventing electrolysis was to insulate the lead sheaths from the earth, or at least try to insulate them. Usually the remedy was worse than the disease owing to it only being possible to indifferently insulate at points in manholes open to inspection; consequently the leakage was transferred to unsuspected points back in the conduits and could not be detected until final breakdown had occurred. The latest practice is to thoroughly ground all sheaths to earth and where distinctly positive to the rails to bond to these rails. This places the sheaths directly in parallel with the rails and permits them to carry a proportion of the return current continuously. Now with a solid cable system, all points of the sheath are in contact with the earth and the bare neutral is a continuous bond around cable joints or other weak sections. The earth acts as an excellent conductor of heat, and it is surprising the amount of return current that a pair of small cable sheaths will carry in this way without dangerous heating. Being uniformly earthed at every point there can be no sharp points of potential difference, and the entire system will drain itself without distress, under conditions such as would be found in connection with a tramway system for a small city, allowing that rail bonds were in fair condition. By fair condition, we mean sufficiently good to permit of ordinary operation of the tramway.

To illustrate the amount of return current which a cable sheath will carry in an emergency, the writer recently had occasion to investigate a conduit cable system where electrolysis was suspected. There were two cables in the system, each with a diameter over the sheath of about 2½ inches. A bleeder cable was connected from these sheaths to the railway negative return cables, and ammeter readings showed as high as 600 amperes under peak load conditions, or 300 amperes per sheath. With this current the cables showed no signs of dangerous heating, even when carrying their usual currents up to nearly the rated capacity of their conductors. If these had been laid solid in the earth, probably no appreciable heating could have been detected. The simple solution of electrolytic troubles is found in providing an easy path for stray currents to leave the sheaths. In a solid cable system, the method of laying automatically provides this means at no additional cost.

Considering the danger from gas explosion in manholes and conduits, a solid cable system eliminates the cause of such explosions as it goes without

saying that explosive gas mixtures can not form if there is no space for them to form in.

Having, we trust, demonstrated that a solid system is as good as a draw-in system as regards reliability, and that it is cheaper as to first cost and superior in some details, it only remains to take up the question of relative cost in the event of additional cables being necessary, over the capacity which can be foreseen at time of construction.

Let us forget the general problem of underground distribution as applied to large cities, and consider only that of a main street system for our smaller city. A main in one block becomes overloaded and requires additional copper. Now the natural thing to do is to run a sub-feeder from the nearest intersection, and tap into our existing mains at about the centre of the block. This means digging up one-half of our ditch in this block at a cost of 69 cents per ditch foot as per previous estimate. This means an increased average cost for the entire block of one-half this per ditch foot, or 35 cents.

Now if we had foreseen this condition at the start, and had laid a conduit system to provide for it we would have selected a six duct line. We probably would not have known from which intersection we would run our sub-feeder, and consequently carry the six duct line throughout the entire block, at an added additional expense of 19 cents per ditch foot.

Our original 4 duct line has been shown to have cost us 93 cents per ditch foot more than the solid system, so that to provide for this draw-in extension we have an excess investment of $1.12 per ditch foot made in order to save a possible future investment of 35 cents per ditch foot. Does not this clearly illustrate the desirability of the solid system of construction for small city construction under paved streets or sidewalks? If so, its desirability for use in residental sections where mains can be laid under grass plots and boulevards, with the eliminations of repaving costs, is beyond question.

Before considering actual details of distribution for such a solid cable system the writer desires to mention actual results obtained from a system of this kind in daily service. There is in Toronto to-day somewhat over 6,000 feet of this type of mains which have been in use for over two years. This was laid in new residential streets where building construction was in process and the certainty of three ditches being dug over our main for every new dwelling erected. These streets are now solidly built up and no additional ditches can be expected except for repairs to services already laid. Under these severe conditions no interference or failures have occurred and in opening up for new services from time to time no depreciation is visible on the cables, which are in condition to-day equal to the day they were laid. It may also be interesting to note that this construction was in unfinished boulevards with sandy soil and outers were only of 2/0 cross section. The cost was about 80 cents per ditch foot or $1.60 per foot of street, mains being laid on both sides. The original supply for these streets was by overhead lines at a cost of about 30 cents per foot of street. This means that under the most favorable conditions underground construction will run not less than five times that of overhead.

Coming down to actual selection of the system of distribution, we have two things definitely fixed in most cases; first, the supply to be alternating

current derived from pole transformers erected on intersecting streets; and, second, a system of ornamental street lighting will be required in conjunction with the commercial system.

For street lighting of this kind the multiple system has definite and distinct advantages over any series system, and should be used in every case where ornamental posts with underground supply parallel the commercial mains. To obtain the maximum economy and simplicity we must connect these street lanterns to our commercial mains, which means individual control of the posts by the patrol system. At first sight this may

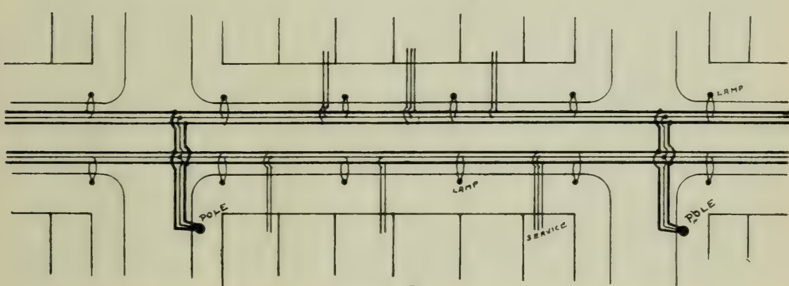


FIGURE 3

seem somewhat crude and like going back to the old gas lamp days. However, just figure out various schemes of remote control for yourselves, and, if you find one which is cheaper than the one-boy power switching system, we will all be very much interested to receive details of same.

The simplest system of distribution is shown in Figure 3, being a three wire main with service taps taken off for commercial loads and street lamps

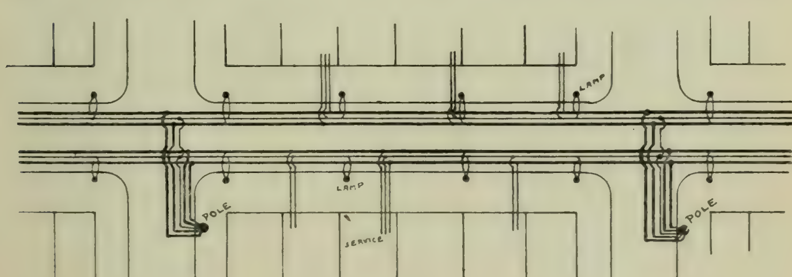


FIGURE 4

and the transformers feeding in through simple tapped branches at intersecting streets. The defect of this system is that a fault will shut down one, or possibly both sides of the system until it can be located or cleared.

Figure 4 shows this defect partially overcome by laying each side of the street as separate sections, multipled at the pole head.

Figure 5 shows a similar arrangement where each block is maintained as a separate unit. This is not advised owing to all street lamps in the block being out if both sides of the system fail for any reason.

Figure 6 shows the necessary arrangement to provide against extensive outages due to trouble on any section of the mains and provides for sectionalizing of the main on either side of any block. With this arrangement each block is fed from each end, transformers being located at the extreme ends

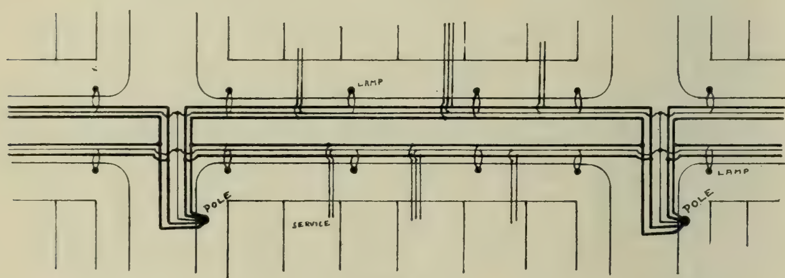


FIGURE 5

of the system in order that no block may have its supply limited to one source. This arrangement permits of opening any main for repairs or changes without interfering with the supply to any customer.

This latter arrangement is a trifle more expensive than some of the simpler plans, but the additional expense is well warranted by the added convenience of being able to quickly sectionalize trouble and thereby get

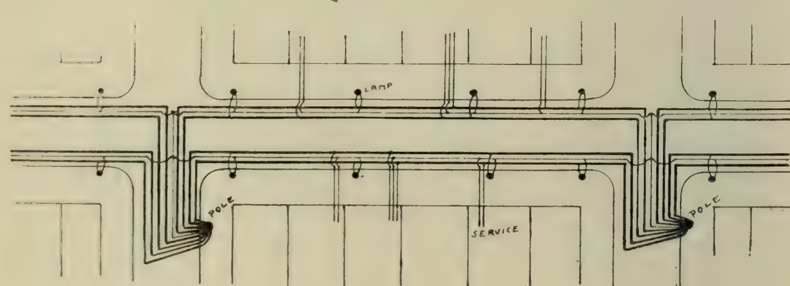


FIGURE 6

service restored to the majority of customers in a very short time. The trouble with such a scheme is the difficulty of making a good job of bringing the eight cables up the terminal pole, requiring four pipes or protecting troughs and a cumbersome paralleling bus arrangement on the pole top.

Fig. 7

Fig. 8.

To overcome this the "Pillar Box" has been designed as shown in Figures 7 and 8. This box is supported on two concrete piers going down below frost line, the box being secured by a pair of anchor bolts embedded in the concrete. The standard box as shown is what is known as a ten stub box, terminals being provided for ten outgoing leads on both positive and negative sides of the system. Each polarity is kept separate with a removable asbestos board barrier intervening. This design makes it easy to work without danger of short circuit and provides a quick and easy means of testing and sectionalizing without necessity of going up the pole or opening subway

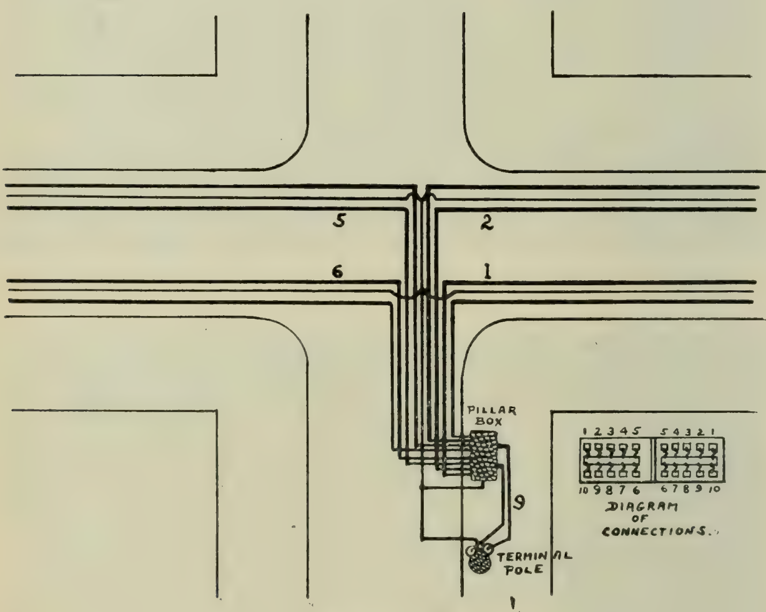


FIGURE 9

boxes, the latter being a tedious and unpleasant task in winter weather with everything below ground covered with a layer of snow and ice. Figure 9 shows the method of connecting one of these pillar boxes for an intersection, such as shown in Figure 6, the box being preferably located on the curb line of the intersecting street just back of the building line of the main street. Figure 10 shows a similar box connected for an intersection on which underground supply is used on both the main and intersecting streets. In this application the feeder line is carried over the intersecting street to the point where transformers are located overhead; or if an extensive system is main-

tained, the transformer may be in an adjacent vault and the high tension supply cable laid underground from the nearest pole terminal, where high tension fuses are located. This type of construction does away with all necessity of getting to the transformer vault for fusing or disconnecting and forms an ideal method of distribution for a fairly large city, particularly if a common neutral primary supply system is maintained. With such a system a small single conductor primary cable is all that is necessary. Figure 11 shows a sectional and plan view of such an arrangement.

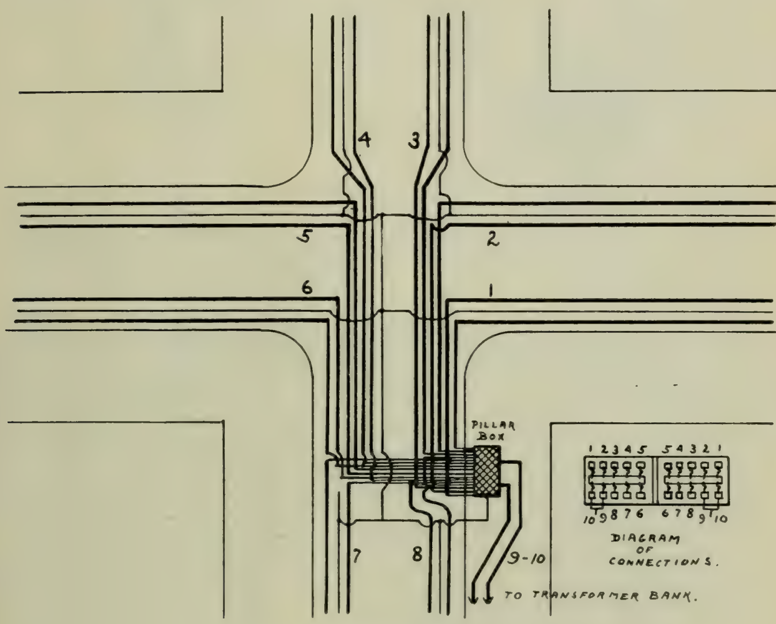


FIGURE 10

The cost of these pillar boxes complete, with hot galvanized finish throughout, is about $100 each, or approximately the cost of trying to get the entire bunch of cables up the terminal pole.

In the case of long or important business blocks it is often desirable to be able to further sectionalize a main in the event of trouble. This is readily accomplished by running in what is known to us as "loop service" and consists of simply cutting the main and carrying both ends into the building and connecting same at the service entrance through a loop box. The service wires are then, of course, the full size of the main. In general the loops are located in the more important buildings and not only furnish a ready means of sectionalizing, but allow of this important customer being supplied from

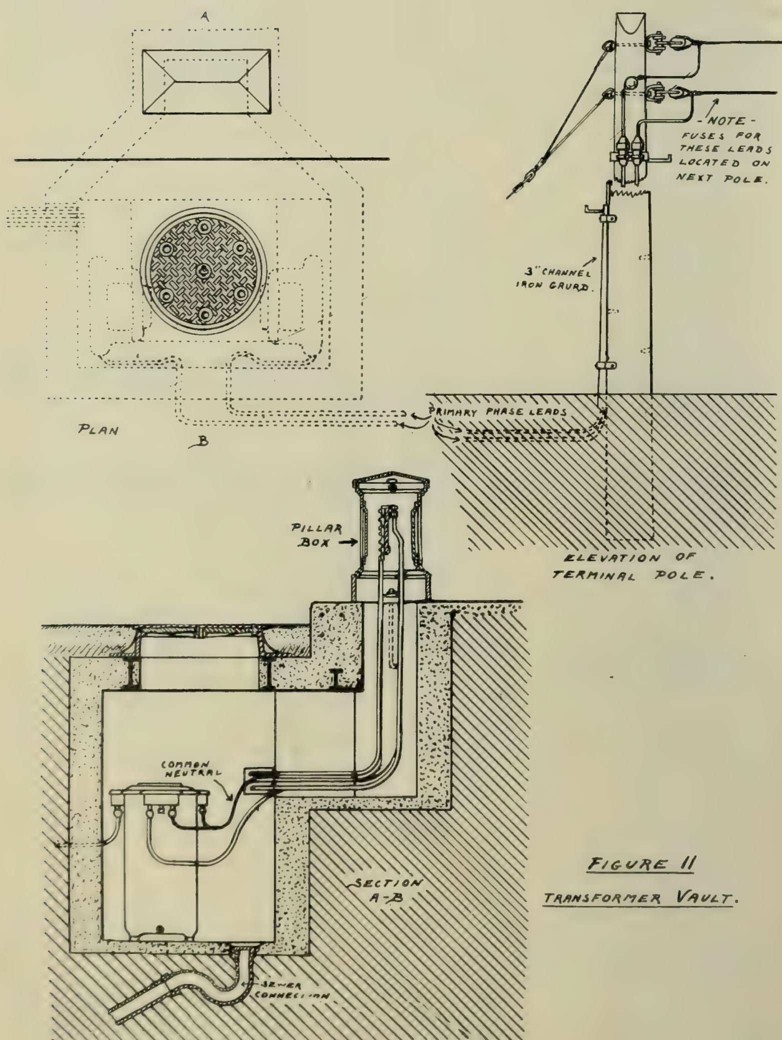
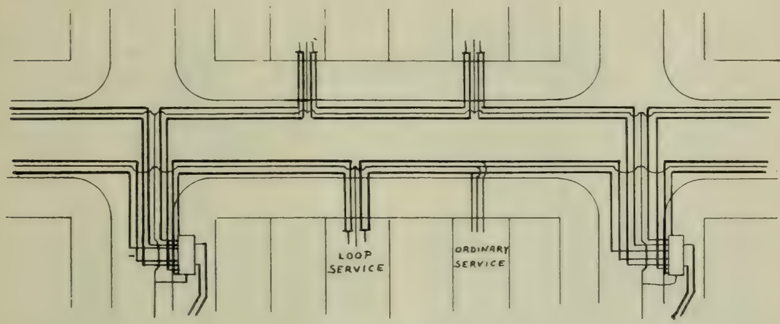


FIGURE II
TRANSFORMER VAULT.

either end of the loop while locating and repairing a fault. Figure 12 shows the method of looping and Figure 13 a typical combined loop and service box.



- FIGURE 12 -

The details of terminal and transformer pole arrangement for the system should have careful consideration, as they form the heart of the entire network. Cables must be provided with weatherproof terminal bells to

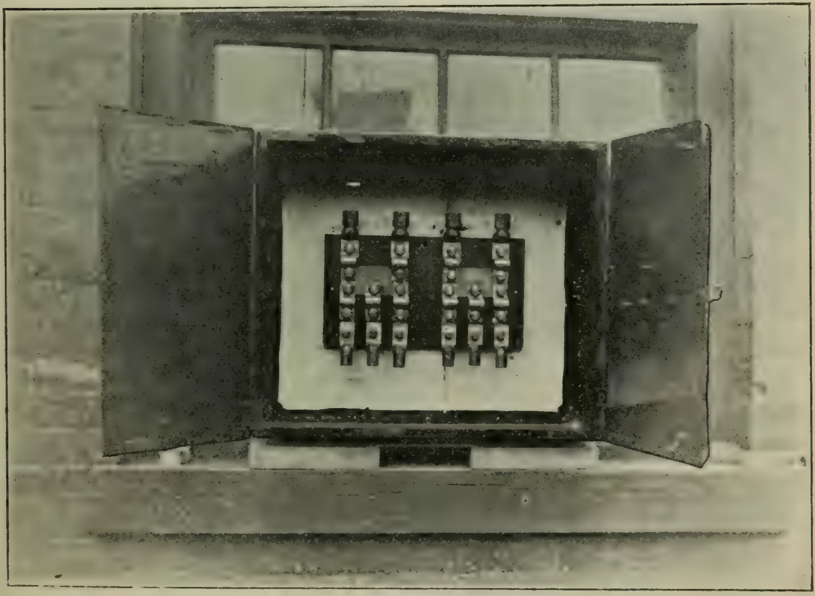


Fig. 13

"potheads" and fuses are necessary unless the cables lead directly to a pillar box. The transformer should not be located on the cable pole, but

on the next pole on the line, in order that linemen may not be called upon to handle a "death trap" caused by high tension apparatus being located on a pole which is "grounded." The general arrangement is shown in Figure

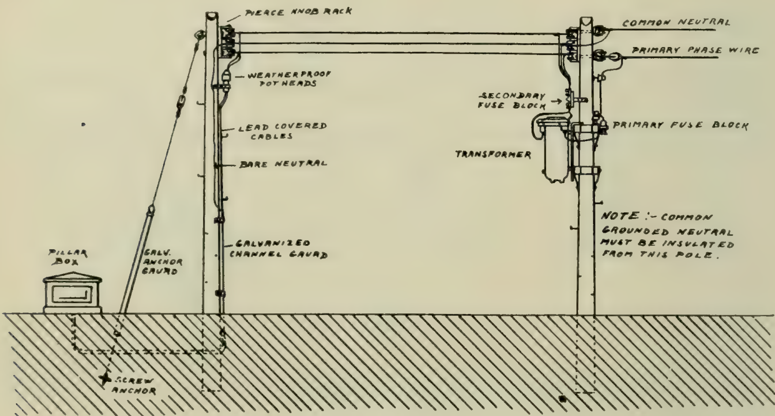


FIGURE 14

14, the detail of fuse block in Figure 15, and details of cables and "terminal bells" in Figures 16 and 17. The latter is a "loop" terminal and would apply to the extreme ends of a main street, where the two mains, in place of entering a pillar box, are carried up the pole.

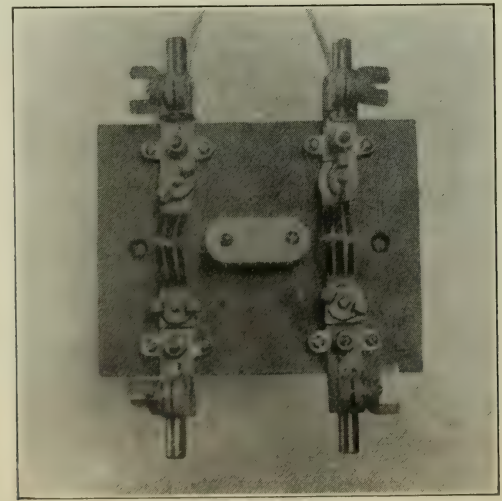


Fig. 15

With a system of this kind all power demands must be met with single phase motors, which usually is not difficult owing to individual motors in the business section seldom being of large size. The principal objection to motors of this type usually comes from the customer, owing to their higher cost as compared to multiphase type. If it should be necessary to meet this situation the supply company can well afford to pay the difference rather than yield to the demand for polyphase supply on which the excess investment for mains, services and meters, will be considerably in excess of the difference in the cost of the two types of motors.

Several systems of polyphase underground supply have been tried out,

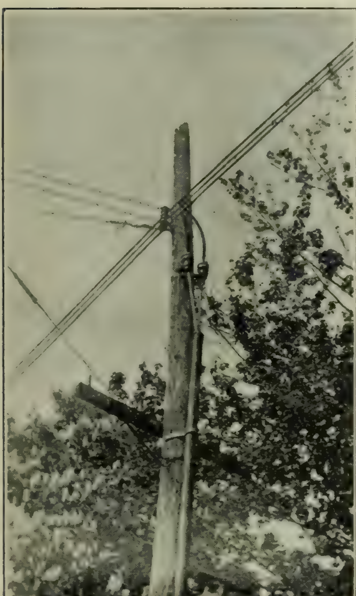


Fig. 16

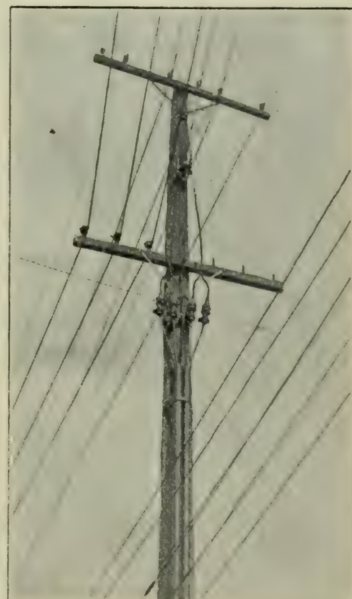
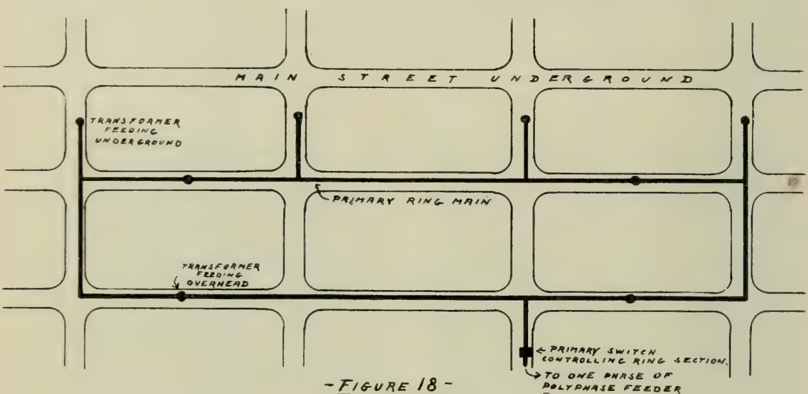


Fig. 17

but, in the writer's opinion are objectionable. One of these is the four-wire system, giving 115 volts from each of the three insulated phase wire sand the common neutral, and approximately 200 volts acrss phases. This system requires a motor voltage which is not standardized and requires balancing in three sections in place of two with the ordinary three-wire single phase system. Copper cost is also higher than with single phase.

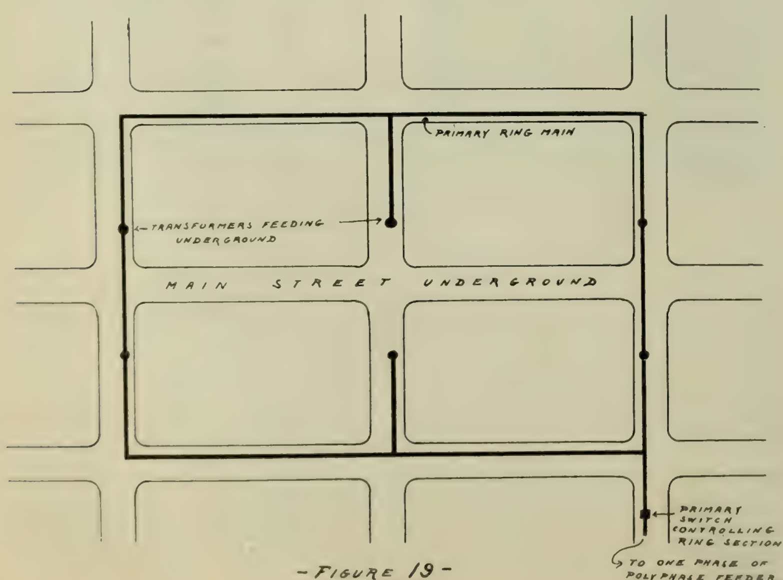
The other system is a straight three phase 550 volt delta on which dry type single phase transformers must be installed **on the customers' premises** for stepping down the power voltage for lighting. The use of such a system is a twenty years step backwards. The cost of transformers alone will offset any possible saving in copper, to say nothing of core losses and added fire risk to the customer's premises.

In conclusion we would call attention to the desirability of having the primary supply for the suggested underground system arranged as a ring main. The secondary, to get full advantage of diversity factor and consequent low copper and transformer costs, must be interconnected. With a single line primary a break in the line will cause considerable trouble in the low tension network, owing to the transformers on live side of break not



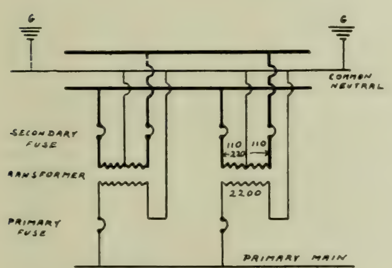
-FIGURE 18-

only feeding their own load but supplying step down current which will go through the intervening mains and step up again in an attempt to supply the load beyond the break. This primary ring may be arranged as shown in



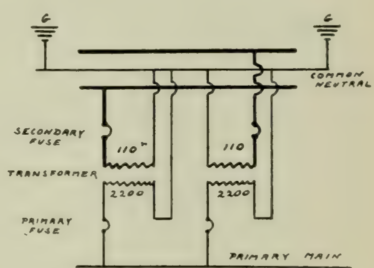
-FIGURE 19-

Figure 18; or may be a ring encircling the underground section, as shown in Figure 19; in which case the pillar boxes may be dispensed with and loops carried up on intersecting streets on both sides of the main street. With moderate loads this will involve using more transformers of smaller sizes, with corresponding increased cost. If, however, the load at each intersection is in excess of 15 K.W. then the additional cost will not be appreciable. This is due to the fact that a 15 K.W. transformer is about as large as one can safely use as a unit on general distribution, so that for heavy loads two transformers at each intersection would probably be required. In this case it makes little difference whether they are on the same side or opposite sides of the main street. Just a word of warning however. If you require two transformers to feed into the same point don't connect them in multiple, as



IMPROPER METHOD OF BANKING A PAIR OF TRANSFORMERS.

-FIGURE 20-



PROPER METHOD OF BANKING A PAIR OF TRANSFORMERS.

-FIGURE 21-

in Figure 20. If you do, don't be surprised when they both drop their load at the same time, which they will ninety-nine times out of a hundred. Connect them one to each side of the three wire system, as in Figure 21, and let each take care of its own part of the network.

DISCUSSION.

THE PRESIDENT: We would like to have a good discussion on this paper of Mr. Hood's.

MR. L. W. PRATT, Hamilton: We have not quite reached the point where we are underground. I think there is a great deal in what Mr. Hood says about the companies being in a large measure responsible for the agitation as to underground construction owing to ancient methods of line construction.

I am not very familiar with that branch of the work, and I think our Mr. Angus, who is present, will be glad to say something.

THE PRESIDENT: We would be very glad to hear from Mr. Angus, Chief Engineer of the Dominion Power and Transmission Company, Hamilton.

MR. ANGUS, Hamilton: I am sorry I am not prepared to discuss this paper, as I have not seen it until I came into the room this afternoon, but it appears to me to be a very valuable paper, and there are a number of suggestions here that look to me very good at first sight. That solid under-

ground construction work certainly cuts the cost down and could be simply and easily handled in most places. I do not know as there is anything special that I noticed in the paper that I would like to speak about.

Mr. A. A. Dion, Ottawa: We put down a number of cables of our own accord for the purposes of feeding from the power houses, within the city, to sub-stations, and to some extent for distribution. We had to face a problem of putting all the wires underground in our main street, which is called Sparks Street. And the municipality, of course, had to do the same thing, and when the engineers got together to devise plans it was found that it would cost a great deal to accommodate both concerns with conduits providing for house to house distribution on both sides of the street, A.C. power for lighting and D.C. power for elevators. The system was very elaborate and complicated and very expensive. And while we were considering the matter I came in contact with an engineer from England who had considerable experience with solid systems over there, and from his conversation I became convinced that we did not give sufficient consideration to the solid system in this country; we had fallen into the lines laid down in the United States of considering that all cables should go in a conduit for accessibility and renewal. He convinced me that the troubles to be expected from the solid system were largely like those of the old gentleman you spoke about, troubles that never happened, provided you got good cables to start with. The system has very many advantages and it makes a great saving for the companies that are compelled to put the wires underground. And where they are brought before the Commission, as the companies in Hamilton have recently been, it may be possible to effect a compromise as to cost by suggesting to the Commission a solid system and getting an order to that effect.

I commend that all engineers and managers study well this solid system in all its bearings, and Mr. Hood's contribution is very timely and more valuable because he did not merely make a general argument for the system but he gave us a concrete example of a working system in which he has eliminated most of the difficulties.

I would like to ask Mr. Hood regarding these loops, whereby he can sectionalize conductors in case of trouble—whether the switching devices are placed in the box outside or within the customer's premises?

Mr. Hood: The loops are brought into the basement and connected with the service box, as illustrated on page 83, fig. 13.

Mr. Dion: Another question—in taking out services from the mains, in the case of ordinary service, not a loop, what means do you use? Use split box or sealed joint?

Mr. Hood: We use a sealed split box.

The President: I am sure there must be some other members who would like to ask Mr. Hood's advice about some of their troubles.

Mr. Croucher: There is one point that Mr. Hood has failed to bring out which we find in the way of practice, and that is, that we have to contend with very severe frosts in this country which they do not have to contend with in the Old Country, and in chipping out the soil to make a joint, a service joint or any other joint, in the solid system there is that danger of chipping or your chisel going too far and making a short circuit; other-

wise we have found the solid system to work pretty well. But there is that danger which exists in the City of Toronto, which does not exist in the Old Country, where they don't have to contend with the severe frost.

MR. DION: How deep?

MR. HOOD: Sixteen inches, or probably two feet on a paved street.

MR. CROUCHER: This objection stands in regard to frost as much in the draw-in system too. Last winter we had occasion in this city to be called out on to some trouble where there were some foreigners chipping away frost near a store. When I arrived on the ground I found they did not know frost from concrete. That concrete was mixed, as I know, 1–3 and 5 in the usual mix, well consolidated, and they were pounding away at the concrete thinking they were pounding away at the frost, and they did not know any better than to come in contact with one of our cables. Fortunately they saw the cable in time to stop hammering. But we have that to contend with. And the most trouble that we have in the solid system is that they would often cut our service with a bar digging a post hole, and not put the service out of business, but they opened the lead sheath so that the moisture gets in at some future time and causes trouble. We have had two cases of that within a week, undoubtedly caused by a bar digging a post hole, which just skinned the lead sheath sufficient to allow moisture to accumulate, and as the moisture got through the paper insulation, it blew out. But in both cases it only put the customer concerned out; it did not blow out the main fuse.

MR. DION: I would like to ask Mr. Hood another question: whether he has figured up the cost using the armored cable—I understand his is just lead-covered—how much increase of cost per foot would you say using iron armored cable?

MR. HOOD: No, I would not recommend iron cable.

MR. DION: Do you know if they have trouble of that kind in England, where they use a good deal of iron?

MR. HOOD: They have some, but not a great deal.

MR. DION: You would rather take chances with lead-covered cable than use iron?

MR. HOOD: Yes.

MR. ANGUS: I would like to ask Mr. Hood one question about grounding of the sheaths of the cable. Does he recommend grounding them where positive to the rails of the street railway? Would he connect the sheathing directly to the track to prevent electrolysis?

MR. HOOD: We ground ours to the water mains.

MR. HARRIS, Toronto Electric Light: In the system of laying solid cables in the earth, there is one question brought up by Mr. Croucher just this minute, and that is, when digging post holes coming in contact with the lead sheath. I would like to keep up the merits of this system by asking Mr. Croucher—by saying that the running board was placed on there, which Mr. Hood gives in his paper, was laid on for that protection; if the bar did come in contact with the lead sheath, why not the running board? Was it omitted in that case?

MR. CROUCHER: I will say that the running board is carried out in principle, but there are cases where you have to get around curves and water

mains where it is impossible to put the running board, and you have to make mitres and joints and small holes to push our cables through, and we depend on the sidewalk and the asphalt pavement for protecting our service, but in some cases where they bore down through the sidewalk and pavements we have lost one or two services. But I for one would advocate the solid system. And I would also advocate lead cover only in place of armored over the main. In tapping a main or making a joint I find it is almost impossible to make that armor up near to its original strength. If you use steel tape there are joints and there are loose places, which is almost no good at all, and the weakest link is the strength of the chain. Therefore I would strongly recommend to use only lead. With lead we can wipe a joint around.

The President: Have we any manufacturers of wire cable here? Now is there opportunity.

Mr. Marshall, Standard Underground Co.: I do not want to appear to be taking exceptions to Mr. Hood's paper or to any of the statements that have been made, but I believe it has been the general experience of cable users that there is more or less danger in laying cables in a trench and putting a board over it and covering it up. England has been spoken of; steel tape, armoured cable is used very largely where solid systems have been installed and it has been very satisfactory. I do not know of any considerable trouble owing to steel tape being placed in proximity with lead sheath. I may say that I am familiar with conditions in Mexico City where some 100,000 feet of steel tape armoured cable were laid in the earth; they have no trouble at all due to the armouring over the lead sheath, and I do not believe that the point that Mr. Hood has taken there is entirely borne out in practice. However, we make both iron cable and lead covered sheath. (Laughter.)

I have had some experience in testing cable and in examining systems throughout the United States and some systems in Canada. And I recall one case where conditions, perhaps, are different than in Toronto. This was along the seashore, where considerable cable was installed in the manner described by Mr. Hood, and they had considerable trouble with it. We tried to determine what the cause of the trouble was, and there was some difference of opinion. In some cases at least we felt that it was peat acids, which you are likely to encounter most anywhere, and particularly, of course, in swampy ground. In other cases, possibly due to the cable being laid in the earth, where it was constantly near the ocean there, and the waves in the winter time breaking over and thoroughly saturating the ground with salt water. Some engineers thought that was probably the cause of the trouble.

Mr. Hood made a point there in respect to electrolysis, and made the statement that the lead sheath is grounded at all points. That is true; perhaps more so than when installed in the conduits. But it is possible that the cable might be installed in dry earth for a considerable distance, a mile or so fairly dry earth, and then strike a wet spot and the lead sheaths might collect enough current, especially crossing underneath the street railway, so that the current would leave the sheath at the wet spot and probably cause trouble. However, we are not free from electrolysis trouble in any system; there is more or less danger of that.

The other point I want to make is, in the draw in system it is possible for engineers to protect their system so that they can be reasonably sure of little trouble, at any rate from electrolysis. And they do that by making electrical surveys of their system, probably monthly, and at the points where the lead sheath is positive to the grounds they can connect or provide a metallic bath for the current and in that way reduce the danger to the minimum.

I would like to ask Mr. Hood whether he would apply his remarks to any system, or just to small systems?

THE PRESIDENT: One of the great advantages of our Association is the free interchange of opinion between those holding different points of view. I would like to hear from one of the consulting engineers.

MR. A. L. MUDGE, Electric Power Company, Toronto: A point occurred to me in connection with what Mr. Marsh said. The cable referred to as being put in at Mexico City and being covered with a steel tape was no doubt a three phase cable, whereas the cable that Mr. Hood speaks of is single conductor cable, so that the conditions would be somewhat different. There would not be the same objection to having steel tape around three phase cables, whereas there would be a serious objection to having it around single phase on account of the heating of the steel tape by eddy currents in the steel.

I would like to ask Mr. Hood as to the cost of taking services off the cable system that has been spoken of.

MR. HOOD: It would average us about 30 to 35 cents a foot. An ordinary draw-in system would run about $1 per foot; the solid system would run about 35 cents a foot or, roughly, about one third as much.

A DELEGATE: And what would the cost of making a joint be?

MR. HOOD: Probably $1.50 to $2.

MR. PRATT, Hamilton: I understand that one of the reasons for the great success of the solid system in England is due to the fact that over there conditions are stable, that engineers can figure more closely on their ultimate requirements for a long time to come, whereas in this country a system laid to-day would be utterly inadequate to handle the load five or six years from now. And it would appear to me that the draw-in system possesses an advantage over the solid system for that reason. I would like to know from Mr. Hood if the solid system is built to meet that condition.

MR. HOOD: If you cannot figure ahead on your probable ultimate load, it is a question whether the draw-in system would not be the cheapest in the long run; but in the case of a small town where you are putting the main streets underground you can figure pretty closely what would be the ultimate load.

MR. MACLACHLAN: In case you are grounding your lead sheath, why not use that as your neutral? Use your lead sheath as neutral and do away with your neutral altogether?

MR. HOOD: In some cases you do, but we do not tell anybody. (Laughter.) We also use the water pipe occasionally.

MR. CROUCHER: He mentioned about electrolysis—taking a survey once a month. I think where there is a grounded system run with trolley system, with five or six sub-stations, it is almost impossible to have an electrolysis surveyonce a month; it is not impossible to have the survey, but it is

almost impossible to put the results together and form any idea what you are going to get. One part of the day when he is taking that survey, may be North Toronto has a peak load, and next time he takes it that station may be shut down and may be the run is from West Toronto, and next time they take it may be both those stations are shut down and they are drawing power from Front Street, and whichever station is running in the trolley system that is where the return current is going back to, whether going over the lead sheath or water pipe or rails or anything else. Now then, if you ground your lead sheaths at every point, whether it is in dry ground or wet ground or draw-in system or solid system, ground at every possible point you can both to return to the earth, it does not matter which way it gets back to the Street Railway Company, it will get there. And we find by grounding everything solid to the Street Railway, water pipes and every other available ground, that we have very little trouble with electrolysis. That has been our experience in Toronto. We have had an underground system here now for some years, and there has only been one or two cases where we have had any doubt about it being caused by electrolysis, and that we had in the old Edison system as well as in the lead sheath. I have been by the old Edison system some times when I have seen a spark jump off a conduit to the wet earth. You think that is pretty bad. It was pretty bad. And we found quite a lot of trouble at that point, and since we have grounded everything in the way of sheaths and conduits to the rails we have had very little trouble.

Mr. A. T. Hicks: I would like to ask Mr. Hood regarding page 83, where he has vertical construction shown there—that is, primary lines I presume? I would like to know if he had any difficulty at all in the primary wires getting together.

Mr. Hood: Those are secondary lines where they came up from the underground main.

Mr. Merritt, Toronto Electric Light: I would just like to ask Mr. Hood what his objection was in banking his transformers in the way he shows in that last figure, fig. 20. I would like him to explain that.

Mr. Hood: That is where there are two transformers located very close together. For instance, on one pole and they are both in parallel. Now, when a short circuit on the main blows the fuses, of course either one or the other will go first; they won't both go at once. But if they are under those conditions, or if the short circuit continues for any appreciable time, as soon as one cracks out the other will follow. If you connect them as in fig. 21, trouble of that kind will simply put out the side of the system affected and will leave the other operating.

A Delegate: There is a possibility of one transformer taking all the load perhaps and the other one only working a small percentage of the load when they both feed in that way. The other way when in parallel the load is divided up equally between them.

Mr. Hood: When connected in series as fig. 21, each transformer is entirely independent of the other.

Mr. A. A. Dion: There is one point I am not just clear on. You stated in one case a possible objection to using single conductor lead covered cable, and then you use it. I did not follow your reasoning there.

Mr. Hood: In using single conductor cable all wires must be in one conduit or pipe, if of iron and circuit carrying A.C. current. If this is not done serious inductive effects will result. This necessity sometimes caused difficulties of a mechanical nature during construction, but not often.

The President: I am sure we all appreciate Mr. Hood's very valuable paper. It has been demonstrated by the amount of discussion and interest which has been shown in the discussion. Anyone who would like to get further information, I have no doubt Mr. Hood would be around the building for the next couple of days and would be very glad to give any information which anyone would require or desire to have.

Mr. Maclachlan: I move we adjourn. This was seconded and carried.

SECOND DAY—MORNING SESSION.

Thursday, June 26th, 1913.

Session opened at 10 a.m.

The President: We will now open up the morning Session by the reading of the paper "Magnetite Street Lighting," by L. Burpee, Canadian General Electric Company, Ltd.

MAGNETITE STREET LIGHTING

By L. Burpee

Of the Canadian General Electric Co.

Street lighting by electricity was first done successfully by the old D.C. open arc lamp. It, however, had two very objectionable features, in that the life of the carbons was very short, namely, about 16 hours, and that, though the volume of light emitted and efficiency were high, the distribution was very poor and not at all ideal for street lighting. This was due to the fact that the light emanated almost entirely from the crater of the upper carbon, giving a maximum of intensity at about 45 degrees below the horizontal.

The introduction of the enclosed arc lamp was a step in advance. The life of the carbons was increased to between 100 and 150 hours per trim, and in addition by the use of an opal globe and reflector the distribution of light was much improved, in that the dark shadows and bright rings found in the vicinity of its predecessor were eliminated and the range increased.

With the perfection of this lamp, it became apparent that nothing further could be done to materially increase the life and efficiency of carbon electrodes. This fact, coupled with the demand already prevalent for a high efficiency, long-burning lamp, led the engineers of the General Electric Company to turn their attention from the carbon electrode in search of one which would satisfy the demands. A long series of experiments was, therefore, carried on, which resulted in the production of what is known as the Magnetite electrode, from which the lamp in which it is used gets its name. The electrode consists of a thin sheet-iron tube, electrically welded at the seam and filled with a heavy black powder of three ingredients, 72% of which is magnetic iron oxide. The remainder is in part Titanium oxide, which increases the efficiency of the arc, and in part Chromium oxide, which increases the life of the electrode.

Experimenting did not end here. Light from a carbon lamp emanates almost entirely from the ends of the two carbons in the alternating-current lamp or from the end of the positive carbon in the direct-current lamp, and a very small amount of deposit results from their consumption. In the case of the new or Magnetite electrode, light emanates entirely from the arc, and in its consumption a large amount of brownish fumes is produced, necessitating a lamp differing very materially from those at that time on the market. It was absolutely necessary to establish in the lamp a continuous draft, so arranged that fumes would be prevented from coming into contact with the globe and could be carried out of the lamp. This done, a very careful study of the arc was made, and experiments carried on, with a view to raising the efficiency of the luminous arc to a max-

imum. In this connection we refer to Fig. 1, cut of an early type of the lamp in which the upper was the negative or Magnetite electrode.

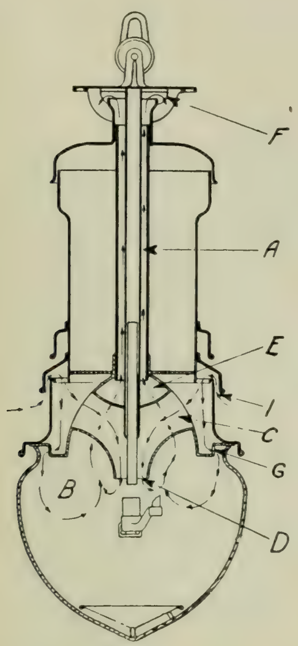


Fig. 1—Early Type of Luminous Arc Lamp with Negative Electrode Above and Positive Below.

In this arrangement it was found that the negative material, liberated from the Magnetite electrode, did not fill the entire arc stream, due to the fact that the natural draft set up by the heat of the arc forced it upward and out of the arc, with the result that the lower part of the arc stream was not up to the maximum intensity. To overcome the effect of the natural draft the incoming air was directed by a nozzle placed around the arc, so that it formed a downward draft about the arc. This increased the efficiency somewhat, but not to the desired degree, though at the same time it produced by conflict with the natural up-draft an instability of arc, causing it to wander considerably. The air, as will be seen, entered the lamp at "I," a part entering the globe chamber "B" at "G," the remainder passing down over the arc at "D," entering the chimney "A" at "E," and escaping under the weather cap at "F."

With the negative placed below the positive, it was found that there was no difficulty in filling the entire arc stream with the light-giving material from the negative electrode, as the natural draft caused by the heat of the arc carried the material to the extreme upper end. The air in this design of lamp was admitted, as shown in Fig. 2, at "I" as before.

It passed to the globe chamber, between the globe and the edge of the reflector "J," turned and swept up, passed the arc, keeping it central and comparatively steady, assisting rather than opposing the natural draft. This resulted in a decided increase in efficiency, since the arc became luminous

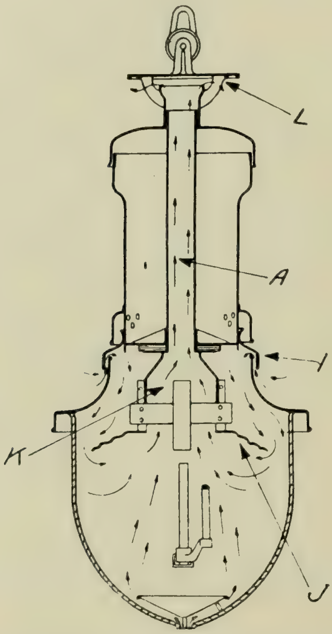


Fig. 2—Diagram Showing Circulation of Air.

throughout its entire length. Having passed the arc, the air, fume-ladened, passed through the upper electrode box "K" into the chimney "A," and escaped into the open air at "L," under the weather cap as before. A decided advantage gained, too, in this design was in the fact that the upper electrode could be made so large as to run comparatively cool and practically non-consuming.

The lamp, thus designed, was adopted and placed on the market, and has been changed in the last six or eight years only in minor details.

The lamp is very rugged and of simple design, having few parts. The mechanism is shown in Fig. 3, the parts being as follows:

A—Starting Coils.

B—Series Coil of Cutout, B1.

C—Shunt Coil of Cutout.

D—Starting Resistance.

E—Dash Pot.

F and G—Upper and Lower Clutches, which engage with brass electrode rod of uniform diameter.
H—Stop.
J—Upper Electrode
K—Lower Electrode.

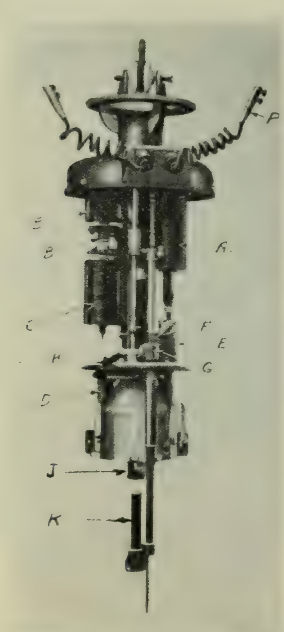


Fig. 3—Later Type of Luminous Arc Lamp.

The concentric circle reflector "J" of Fig. 2 is not here shown. The 4 ampere and 6.6 ampere lamps equipped ready for service are shown in Fig. 4, and the diagram of connections in Fig. 5.

The magnetite electrode is guaranteed for 175 to 200 hours for the 4-ampere lamp, and from 100 to 125 hours for the 6.6 ampere lamp. In actual service the former gives an average of about 225, and the latter an average of about 120 hours.

The positive electrode is made of pure copper rod, covered with an iron sleeve to prevent oxidation. The sleeve and copper rod are drawn down simultaneously from the ingot. In the 4 ampere electrode the copper is $\frac{7}{8}$ in. diameter, and in the 6.6 ampere it is $1\frac{1}{8}$ in. Both are 4 in. long. They are guaranteed to give a life of from 6000 to 8000 hours and 2500 hours respectively. In actual service, judging from reports received from various customers, these figures are materially exceeded. The life for the 4 am-

pere electrode being approximately 8500 hours, and that for the 6.6 ampere 3900 or 4000 hours.

In passing on to consider the lamp as an illuminant, attention is called to the law that light falls off as the square of the distance from the source.

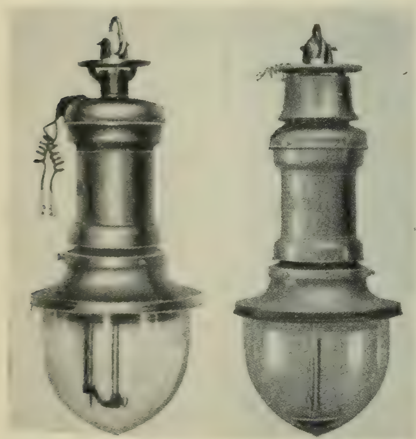


Fig. 4

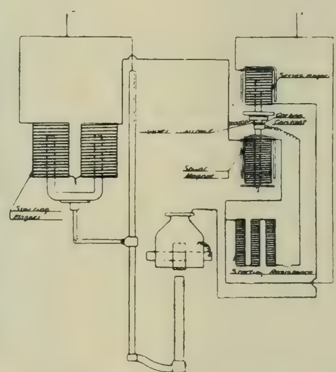


Fig. 5—Diagram of Connections 4 Amp. Form 3 Luminous Arc Lamps.

It was this law that so seriously operated against earlier types of lamps. A good lamp for street lighting should produce a large volume of light with a small consumption of energy, but no matter how great the volume or how economically produced, if the distribution is not in the proper direction, the lamp may be of little practical utility. Comparison of the data given in Figures 6, 7, and 8 will illustrate.

From Fig. 6 it will be seen that the open arc lamp gives maximum intensity of 1250 c.p. at 45 degrees below the horizontal. At 15 degrees below it is only 600 c.p. The maximum of the 4 ampere luminous lamp is 700 c.p. at 5 degrees below, and of the 6.6 ampere luminous 1625 at 10 below. The energy consumption, etc., of these lamps is shown in Fig. 7, where it will be seen that the efficiency of the open arc lamp in watts per mean hemispherical c.p. equals that of the 4 ampere lamp, though its volume of light is much higher, being 813 mean hemispherical c.p. against 523. Reference to Fig 8 will show that, notwithstanding these facts, the 4 ampere lamp gives the same intensity of illumination at 327 feet that the open arc lamp gives at 255 feet, showing the superiority of the 4 amp. Magnetite lamp over the open arc lamp, even though its consumption of energy is but 310 watts as compared with 480 of the open arc.

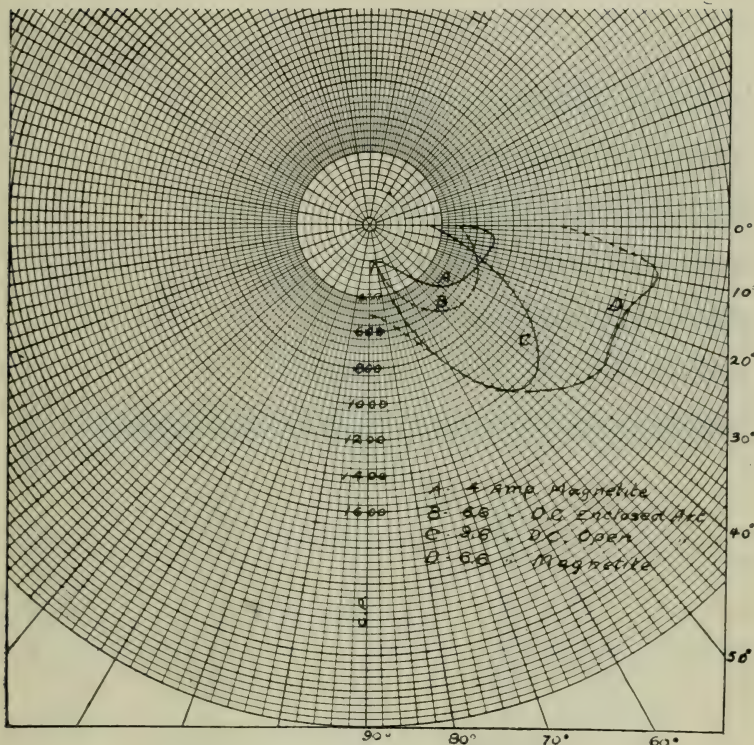


Fig. 6

Lamps.	Amp.	Volts.	Watts..	Mean Hs.C.P.	Watts. per M.Hs.C.P.	Mean S.P.C.	Watts per M.S.P.C.
Open Arc.....	9.6	50	480	813	.59	540	.89
Enclosed D.C.	6.6	70–75	480	505	.95	310	1.55
Luminous.....	4.0	75–80	310	523	.59	276	1.12
Luminous.....	6.6	75–80	510	1328	.38	718	.71

Fig. 7

Further comparison will show that the 6.6 ampere Magnetite lamp, which has an energy consumption only slightly greater than that of the open arc lamp, has an average hemispherical c.p. of 1328, with an efficiency of .38 watts. It gives the same illumination at 510 ft. that the open arc lamp gives at 255 ft. This is equivalent to a range of 2.00 times that of the open arc lamp, or an area 4.00 times as great.

For some years back there has been a strong tendency toward ornamental lighting, especially in congested thoroughfares, and on residential streets and parkways. This was at first accomplished by Tungsten clusters on ornamental standards, spaced at about 75 to 80 ft. on both sides of the street. The efficiency of this system proved to be very low and main-

tenance and operating charges high. The quality of the light, too, was the same as that of the Tungsten lamps used in store windows and adver-

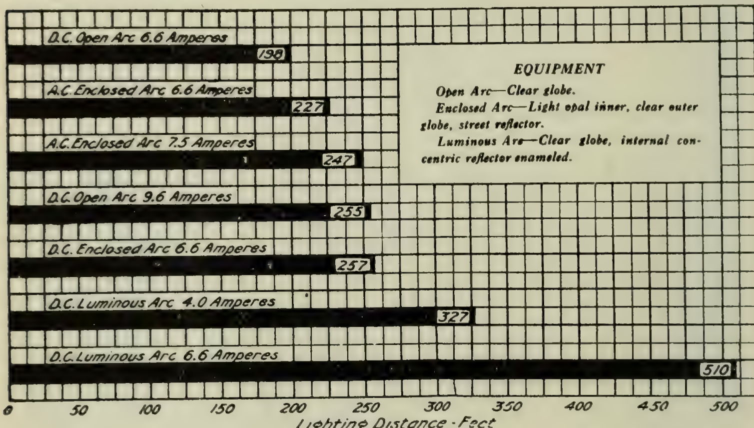


Fig. 8—Comparative Luminometer Distances Street Series Arc Lamps.

tising signs, so that the effect which might be produced by contrast in light of different colors was lost.

In view of the above, the Magnetite lamp has, within the last two years, been adapted to ornamental lighting by redesigning the case, frame and globe, converting it into an inverted form for pole top or bracket mounting. The mechanism which remains practically unchanged is shown in Fig. 9.

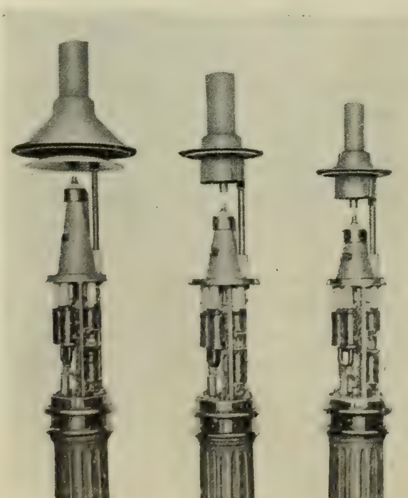


Fig. 9—Parkway, White Way and Residential Street Ornamental Luminous Arc Lamps Showing Standardization in Design of Mechanism.

The three forms for Great White Way, residential and parkway lighting, in which this lamp has been placed on the market, are shown in Fig. 10.

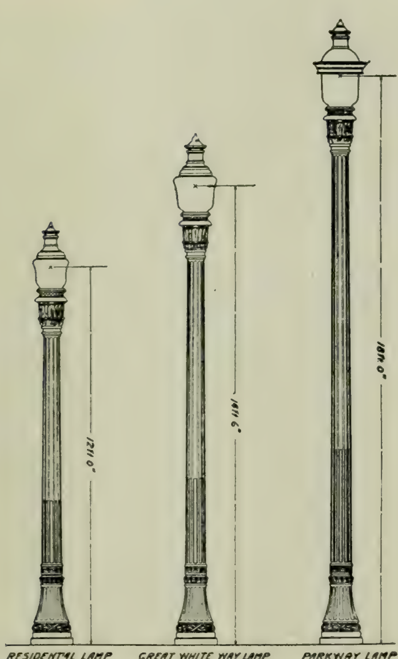


Fig. 10—Ornamental Luminous Arc Standards for White Way, Residential Streets and Parkway Lighting.

Each is designed for a specific purpose, the first to produce a large volume of light of high intensity though of low intrinsic brilliancy. This is brought about by the use of an opal or light alabaster globe on the 6.6 ampere lamp. This globe is just sufficiently dense or opaque to prevent the arc from being seen. It becomes a sort of semi-secondary source of light, and is so designed that a large amount of light is thrown well up on to the buildings, so that not only their outline but much of their detail may be seen as in daylight. The beautiful, white, pearl-like light of these lamps contrasts pleasingly with the comparatively red light of incandescent lamps used in store windows and advertising signs.

The photometric curve of the Great White Way lamp is shown in Fig. 11, and the data in the following tabulation.

Volts terminal	75–80
Volts arc	73–78
Amperes	6.6
Watts	510
Mean Hemispherical C.P.	795
Watts per Mean Hemispherical C.P.	0.64
Mean Hemispherical C.P. per Watt	1.56
Downward Lumens	4993
Downward Lumens per Watt	9.78
Mean Spherical C.P.	725
Watts per Mean Spherical C.P.	0.70
Mean Spherical C.P. per Watt	1.42
Total Lumens	9110
Total Lumens per Watt	17.87

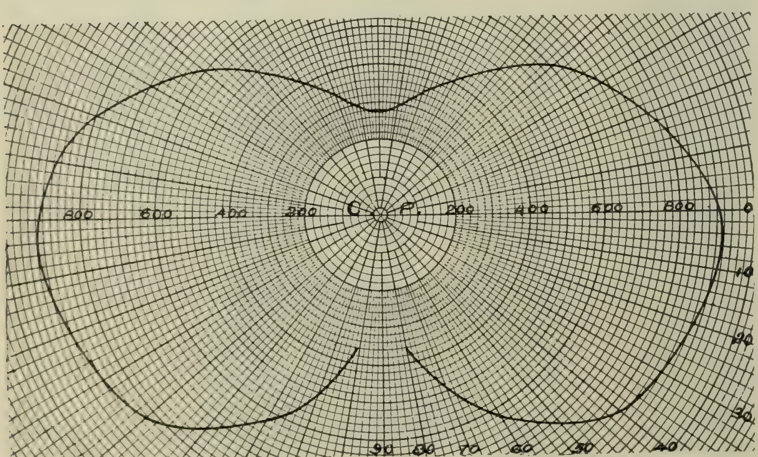


Fig. 11—Readings taken at 25 ft Radius. Medium Alabaster Globe.

In Figure 12 the distribution of light, when the lamp is equipped with the medium alabaster globe, is compared with that of five 100 watt Mazda lamps, equipped with alba globes, the height of the lamps in each case being 15 ft. From these curves the following intensity of illumination at various distances from the posts is found.

Feet from Standard	10	20	40	60	80	100
Ornamental	1.95	1.32	.46	.21	.125	.080
Tungsten Cluster	1.00	.53	.17	.07	.04	.025
Ratio	1.95	2.50	2.7	3.0	3.1	3.2

It will be seen that the illumination obtained from approximately an equal expenditure of energy in the two forms of lighting is about three

to one in favor of the ornamental lamp, with the further advantage that in the latter there is one globe requiring attention and replacing, compared with five in the Tungsten Cluster. To get the same intensity of illumination as is obtained by arc lighting, it would be necessary to place the ornamental Tungsten cluster standards much closer together, thus increasing the cost of not only the original installation but also of maintenance and operation.

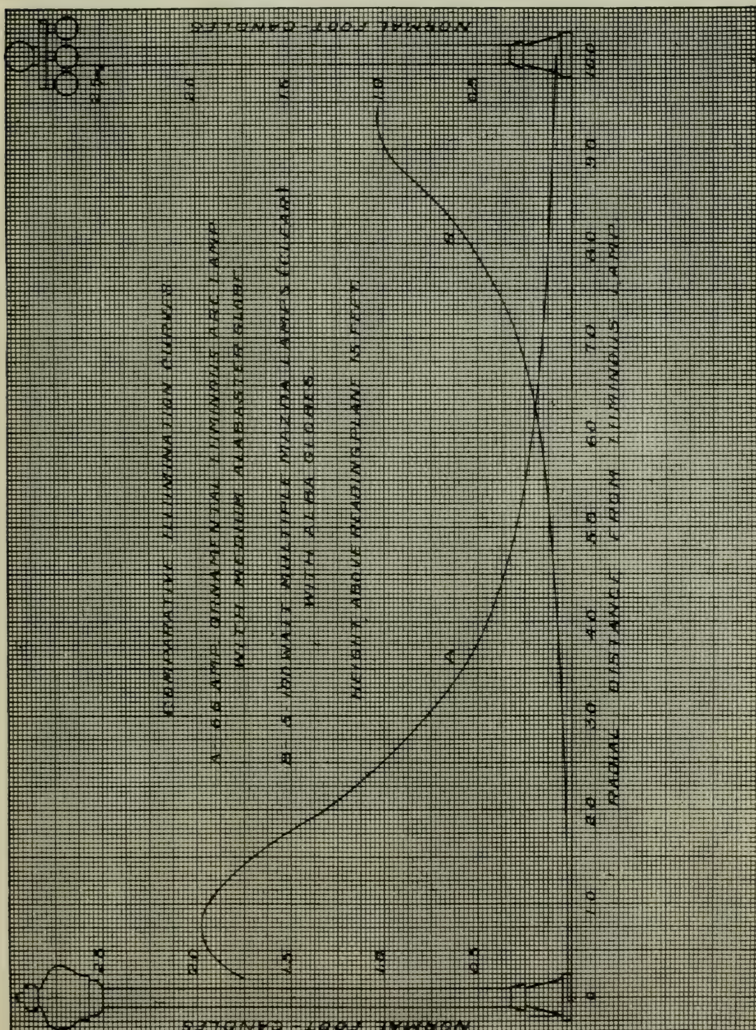


Fig. 12

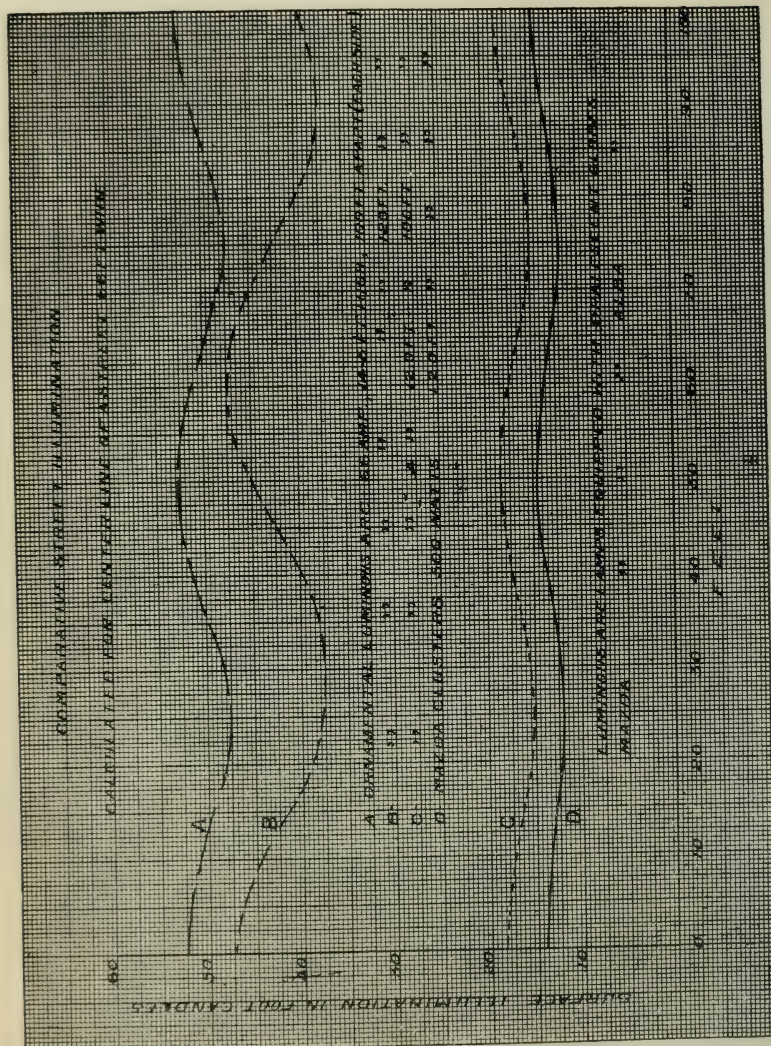


Fig. 13.

Further comparison of street illumination is given in Figures 13 and 14. It will be seen that the 4 ampere ornamental luminous arc lamp, consuming 310 watts, gives approximately 25% more light than the 500 watt Tungsten cluster. In the upper curves comparison is made between 6.6 ampere ornamental luminous arc lamps placed 100 ft. apart on each side of the street, and the same lamps placed 120 ft. apart. These curves show, in a marked degree, the efficiency of the luminous lamp.

The Residential Type consumes 310 watts and is mounted on an ornamental standard of such height that the arc will be 12 ft. above the pavement. This form of lamp makes it possible to obtain good illumination on residential streets where it is usually difficult to get good distribution when the Pendant Type of lamp is used, on account of the foliage.

The Parkway Lamp, unlike the Great White Way and Residential

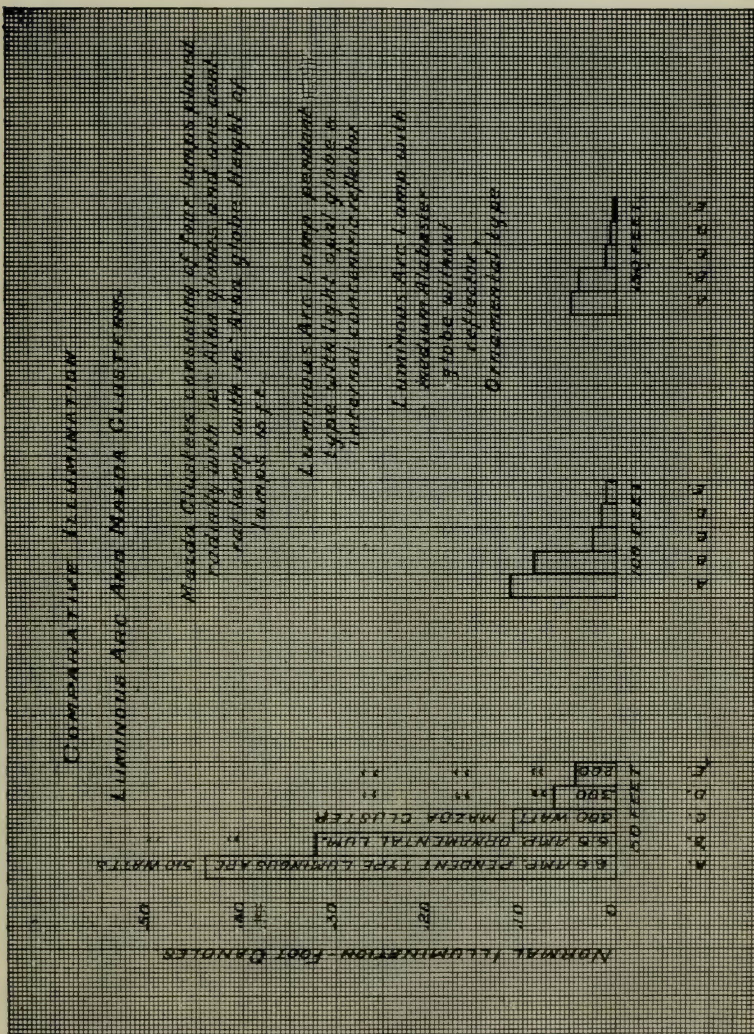


Fig. 14

Types, is provided with an internal concentric circle reflector, such as is used in the Pendant Lamp. As will be seen in referring to Fig. 10, this lamp is intended to be installed so that the arc will be 18 ft. from the pavement, well above the line of vision. In the first installation of these lamps they were spaced 565 ft. apart. Automobiles and pedestrians can be discerned in silhouette with the greatest ease. The

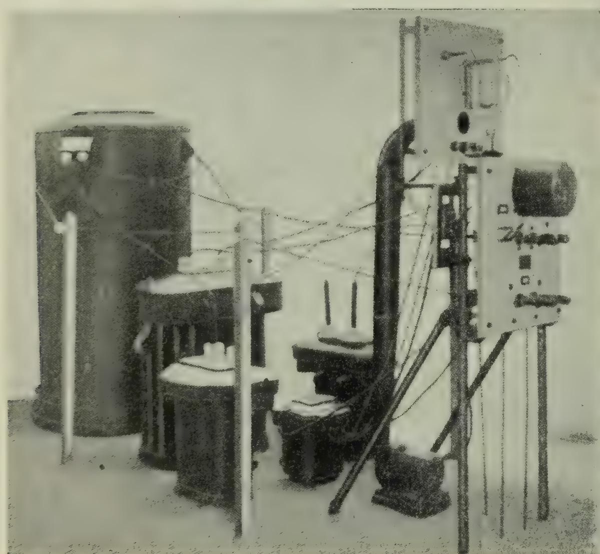


Fig. 15—Early Rectifier Outfit.

principle of silhouette lighting is that most of the seeing is accomplished by the discernment of objects in contrast with the lighted background, which is usually the street surface, rather than by light reflected from the objects themselves. Although this lamp is ordinarily developed for 4 ampere it is possible to furnish it with 6.6 ampere winding if greater illumination is desired.

The appearance of the direct current series arc lamp demanded a source of direct constant current more efficient and more economical as regards floor space than anything at that time to be found. The old Brush arc and Thomson-Houston arc generators had been considered good machines in their day, but they required too much space for the present day power house or sub-station and their efficiencies were comparatively low.

Fortunately it was found that a mercury vapor rectifier could be made to operate successfully as a rectifier of alternating constant current into direct constant current, and experiments were carried out which indicated

that a rectifier used in conjunction with a constant current transformer could be made commercially successful. A cut of the earliest outfit is shown in Fig. 15.

Use was made of a constant current oil-cooled transformer, two reactances placed, one in either anode circuit of the tube, one D.C. reactance placed in the cathode or load circuit, one exciting transformer, one motor and blower, a tube panel and a control panel. Fig. 16 is a cut of the third stage in the development, showing an air-cooled transformer and an oil-cooled tube.

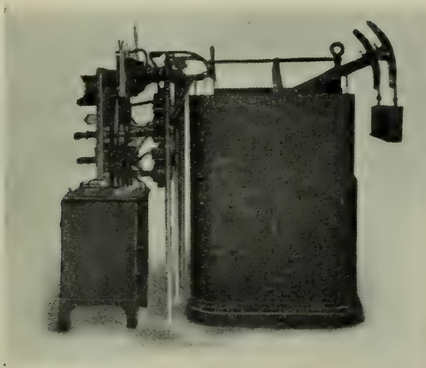


Fig. 16—Later Rectifier Outfit.

The fourth and final stage is shown in Fig. 17. This is known as the combined outfit, where all the parts except the control panel are assembled on one base.

It is hardly necessary to say that tests at the factory could not be carried out under all the conditions likely to be met in actual operation. As a matter of fact, it took several years to find out what a rectifier tube would do in actual service. It was at first supposed that there was hardly any limit within reason to the load that a tube would carry. As an instance, after several outfits designed to carry a load of 50 arc lamps, had given satisfactory results in installations not far from the factory, 75 light outfits were designed and sent to the Pacific Coast. It was soon found, however, that the guarantee of an average of 400 hours for the tubes could not be met. To overcome the difficulty, it was necessary to send from the factory an expert to Portland, Oregon, to change all the outfits to operate two tubes in series on 75 lights.

The next discovery made was that, as the load on a tube increases, the temperature limits between which it will operate successfully, approach each other. Later on it was found that between the limits at which a tube will operate successfully, there is one temperature at which it will give maximum life and the most satisfactory service.

As installations operating under various conditions throughout the

United States began to multiply, various other data of considerable interest and value, from an engineering as well as an operating standpoint, began to increase.

It was found that tubes, after being in operation for an indefinite time, reached a point at which operation became either poor or altogether impossible, while the vacuum was still apparently good. It was at this time that a little device known as the static protector was first employed. Those who are familiar with the operation of rectifiers will probably be able to testify to the value of this part of the equipment. It was found, too, that when a tube with good vacuum refused to operate, it could be made to

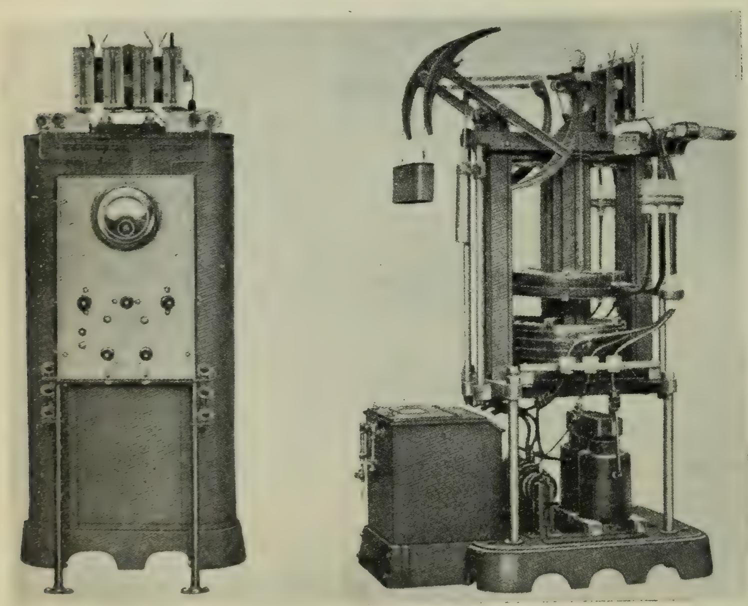


Fig. 17—Combined Outfit. Latest Type of Rectifier Outfit.

Combined Outfit Latest Type of Rectifier Outfit (Casing Removed).

do so by washing with water and Bon Ami or soap. Somebody stumbled on to the fact that tubes which would not operate under any known treatment, would, if set aside for two or three months, revive sufficiently to operate like new tubes. This has resulted in a very material saving to operators. After this point had been brought to the attention of some operators, tubes which were supposed to be of no value, were dug up and to their great satisfaction could not be distinguished in operation from new ones.

There is, perhaps, no one thing in operation which can so completely change the whole complexion of it as the temperature of the oil in which the tubes are cooled. Almost invariably when customers have reported

difficulty in getting satisfactory tube life, an investigation has shown that temperature was the main factor in causing the trouble. It is found for the average tube that the best possible service and life can be obtained between 76 and 80° Fahrenheit. A 6.6 ampere tube, however, will operate best at about 76°.

The oscillograph shows that on a tube, sensitive to temperature, when the temperature at which it gives best service is exceeded, rectification is not perfect. This is shown by the wave crossing the zero point to a certain value in the opposite direction before rectification takes place, at which time the curve falls into the zero line. If the temperature be raised still farther, the curve or wave crosses the zero to such a point that the rectified voltage is not sufficient to carry the load and the coils of the transformer will settle together, preventing further regulation. A still greater increase in temperature causes the tube to drop out, at which time a complete sine wave across it is obtained.

The loss in the 4 ampere rectifier tube is about 100 watts. In the 6.6 ampere it is about 125. The load carried by a 4 ampere tube operating on a 50-light outfit has a maximum of 18 Kilowatts. This makes the efficiency of the tube itself, 99.5%. The efficiency of the combined equipment is not less than 90%, which is a marked increase over that of the Brush arc machine, which had an efficiency of about 82 when belt-driven and about 70 when motor-driven.

For some time after the rectifier was placed upon the market, considerable hesitancy in adopting this form of station apparatus was manifested by some of the more cautious central station managers, because of a want of faith in the tube.

There is, however, no ground at the present time for any doubt as to what the tube will do. There are some three or four thousand tubes in operation every night, throughout Canada and the United States. These are operating under all conditions of load, frequency, temperature, etc., and are giving general satisfaction. Many are exceeding the average life guaranteed by as high as 400 or 500%. The highest average with which we are at present familiar is on 24 tubes in operation at Reading, Pa., the outfits being 75-light, 4 ampere, 60 cycles, two tubes in series on transformers operating on 13,200 volts primary. The average of the 24 tubes in service at last report was 7,478 hours. The longest tube life which we have record of is 16,000 hours.

Mr. Burpee then exhibited a large number of lantern slides, illustrating a paper written by Mr. W. E. Young, of the Canadian General Electric Co., Ltd., on "Ornamental Street Lighting," as Mr. Young was not able to be present.

ORNAMENTAL STREET LIGHTING

By W. E. Young
Canadian General Electric Company, Ltd., Toronto.

Since 1907, when the first ornamental system of street lighting was installed at Los Angeles, Cal., the entire country has demanded a system more ornamental than can be had with the pendant type of lamp. This widespread demand prompted the General Electric Company to develop what is known as the Ornamental Luminous Arc Lamp. The first of these lamps were installed at New Haven, Conn., in the fall of 1911, and since that time approximately five thousand have been sold. It is also to be noted that cities such as Baltimore, Md., Utica, N,Y., Buffalo, N.Y., Rochester, N.Y., Winnipeg, Man., Calgary and Edmonton, Alta., etc., have after trying out these lamps, placed orders for additional lamps.

The phenomenal success of the pendant type luminous lamp is beyond question, and the new lamp is a counterpart of the old one. In fact it is the same lamp with the arc put above the mechanism. Only such changes were made as were mechanically necessary.

The Ornamental Lamp has been developed in the following types:

No. 1.—Exterior View of Three Lamps.

(1) Form 10	- - 6.6 ampere	- -	Great White Way Type.
(2) Form 12	- - 4 "	- -	Residential Type.
(3) Form 14	- - 4 "	- -	Parkway Type.

(1) The Form 10 lamp operates at 6.6 amperes, 532 watts, and 78-83 volts at the terminals. This lamp should only be used for White Way lighting on the principal business streets.

This class also includes large board walks such as Atlantic City, Revere Beach, etc., where great crowds of people congregate. In such places the idea is to have light, more light and better light, and the primary object is to have the highest intensity illumination which will not be unpleasant to the eye. People are attracted to the bright places. This lamp should also be used for display or spectacular lighting, such as fronts of hotels, theatres, cafes, public buildings, etc.

No. 2.—Exterior of Form 10 Lamp.

This is a very powerful unit and it has all the characteristics of the pendant type of lamp. No reflector is used in this lamp for two reasons, viz.: The light would be too intense, and further, the desired White Way effect would be destroyed.

No. 3.—Distribution Curve of Form 10 Lamp.

You will note from this curve the well rounded distribution throwing plenty of light on the adjacent buildings which in turn reflect the light back on the street.

No. 4.—Illumination on Street with Form 10 Lamp.

From this slide you will note the illumination down the centre line of the street. The lamps are staggered according to common practice.

Spacing	Watts per Curb Foot	A.V. F.C.	Max. F.C.	Min. F.C.	Ratio Min. Max.
80	7.32	.632	.647	.614	.95
100	6.00	.52	.552	.485	.878
120	5.06	.44	.484	.376	.777

In making these calculations, the light reflected from the walls of adjacent buildings was not considered as it is of rather uncertain value, depending upon the color and condition of the walls.

A medium alabaster globe is used on this lamp. The upper electrode has a life of 2,000-4,000 hours and the lower 100-125 hours.

No. 5.—Exterior of Form 12 Lamp.

The Form 12, 4 ampere lamp without a reflector operates at 330 watts, 80-85 volts at the terminals. This lamp is in every way similar to the Form 10, only it is smaller. It is, therefore, adapted for the lighting of residential streets. The arc is placed low, only 12 ft. high, in order that the light may be thrown under shade trees. It is also adapted to drives and grounds of large private estates and suburban and country residences. In cities, these lamps should be placed fairly far apart, 150 feet to 200 feet. Often the length of city blocks determine the spacing. One placed at each street intersection and one in the middle of the block give good results.

This lamp could also be used for a White Way, though to a lesser extent, in small cities where a four ampere series circuit is already available.

No. 6.—Distribution of Form 12 Lamp.

You will note that the curve of this lamp is similar in shape to the Form 10. Considerable of the light is thrown above the horizontal. This lamp takes a fine texture Alba globe. The upper electrode has a life of 6,000 to 8,000 hours and the lower 125 to 150 hours.

No. 7.—Illumination on Street with Form 12 Lamp.

From this curve you will note the illumination on the centre line of the street. To be sure it is less than that given by the Form 10 lamp, but is sufficient for residential street lighting.

Spacing	Watts per Curb Foot	A.V. F.C.	Candles Max.	Candles Min.	Ratio Min. Max.
60	5.90	.207	.210	.204	.97
80	4.55	.153	.156	.144	.93
100	3.72	.109	.117	.100	.85

No. 8.—Exterior View Form 14 Lamp.

The Form 14, 4 ampere lamp with a reflector, operates at 330 watts, 80-85 volts at the terminals. This lamp has an entirely different field and is used with an internal reflector and large ornamental hood at the top. It is best adapted for boulevard or parkway lighting where it is not feasible to place lamps close together.

In places of this sort, a silhouette effect is desirable. By silhouette lighting is meant our ability to see by contrast such as illustrated by this slide.

No. 9.—Auto on Marblehead Causeway.

For equal wattages per running foot, it is easier to see by contrast, that is, by placing high-powered units far apart than by placing lower candle power units closer together.

By placing these units 300 to 500 feet apart, a moving vehicle is easily discernible in silhouette against the distant light. This lamp is placed not less than 18 feet from the ground to secure the best results.

No. 10.—Mechanism of Form 14 Lamp.

You will note the reflector at the top fastened to the electrode box by means of two thumb-screws. This reflector throws the light downward and gives the maximum light at 10-20 degrees below the horizontal.

No. 11.—Distribution of Form 14 Lamp.

From the above you will note that this lamp is not adapted for White Way lighting, as the white way effect is missing. The light which would otherwise be thrown on the building is redirected downward in order to secure maximum light along the road surface.

Summarizing, the conditions are as follows:—The Form 10 lamp is for business streets, the Form 12 is for residential streets, and the Form 14 is for roadways and parks.

No. 12.—Mechanism of Three Lamps.

The three lamps are in every way similar and below the nozzle plate the Forms 12 and 14 are identical with the exception of the lower electrode holder.

No. 13.—Lamps on Poles.

We recommend that these lamps be mounted as follows:—

Lamps	Height of Arc.
Form 10	14′ 6″
Form 12	12′
Form 14	18′

While these figures are not absolutely invariable, we believe the best results will be secured if the above is adhered to.

City Lighting.

City lighting may be divided as follows:—

(a) Principal business streets.
(b) Important cross streets.
(c) Residential streets.
(d) Outlying districts.
(e) Drives, boulevards, parks.

For the first two classes, the Form 10 is recommended, while for the third and fourth, where less intense illumination is desired, the Form 12 is best adapted. The last class is distinctive and can only be filled by the Form 14.

Principal business street lighting may be divided as follows:—

(1) Temporary.

(2) Permanent.

Temporary street lighting refers to special or spectacular lighting of a high order for a celebration, carnival or exhibition, such as the Toronto Fair, or big political conventions. In the past, this lighting has usually taken the form of incandescent lamps outlining the buildings and further assisted by high powered searchlights. In the future, the ornamental luminous lamp, because of its higher efficiency, will play an important part in this work.

The permanent form of ornamental street lighting covers a very broad and unique field and is now recognized as one of the best forms of municipal advertisement. The first installation of this kind was at New Haven in 1911, and on the opening night thousands of people came from out of town. One of New Haven's merchants said he would not take $5.00 for every one the system cost him, and the merchants there paid the entire cost of installation and maintenance.

This lighting is usually classed as Great White Way lighting, a name which was first applied to New York's famous Broadway. Merchants are nearly always willing to pay their share of the expense for such an installation.

No. 14.—Advantages of the Great White Way.

(1) Increased business to Central Station.
(2) Increased business to merchants.
(3) Attracts out of town buyers.
(4) Psychological impression of thrift and progress.
(5) Lessening of overhead wires.
(6) Advances civic pride.
(7) Promotes other improvements.
(8) Decreases crime and robbery.
(9) Credit to city administration.
(10) Attracts industries.
(11) Increases real estate value.
(12) Facilitates congested traffic.
(13) Improves sanitary conditions.

Some public officials claim that a light is as good as a policeman, and while this statement may be somewhat optimistic, there is no question but that the light is a foe to the hold-up man.

No. 15.—Advantages of Ornamental Luminous Lamp.

(a) Illumination.

(1) Distribution—Apparent uniform distribution over street areas and building fronts.
(2) Quality—Beautiful pearl white light of high CP and low intrinsic brilliancy.
(3) Steadiness—Steady updraft—Focusing arc.
(4) Shadows—Shape and density of globe eliminates shadows on streets and buildings.

(b) Outages.

(5) Mechanism—Similar to Pendant type, of which there are over 150,000 in use on this continent.

(c) Operating Costs.

(6) Efficiency—Approximately 1000 CP at 510 watts giving higher efficiency than any other ornamental lighting unit.

(7) Upkeep—Lower than any other system.

1. Simplicity—Rugged, accessible, easy to install.
2. Trimming—Easy, quick, accessible.
3. Electrodes

Electrodes	Upper	Lower
Form 10	2000-4000	100-125
Form 12	6000-8000	125-150
Form 14	6000-8000	250-300

4. Globes—Heat resisting not removed to trim.
5. Repairs—Strong, simple, liberal design.
6. Safety—Thoroughly insulated frame and casing.

(d) Depreciation.

(8) Practically indestructible from usage.

(e) Initial Cost.

(9) Fewer standards.
(10) Less cable in standard.
(11) Less labor per unit.
(12) Lower cost for standards.

Saving in number of lamps, labor, standards, etc., will more than compensate for additional station apparatus on large installations. On small maintenance counterbalances higher initial cost.

A properly lighted Great White Way should fulfil the following conditions:

(1) The distribution of light over the entire street surface and building should be apparently uniform as far as the naked eye is concerned.

(2) The light should be sparkling, yet not dazzling and offensive to the eye. It should be soft and white in color and approach daylight as nearly as possible. To produce this effect, the light should emanate from the secondary source of light, such as a diffusing globe, which should be dense enough to kill the intrinsic brilliancy of the primary source and yet not absorb much light.

(3) The light should be steady and free from flicker and of unvarying amount throughout the life of the trim. There should be no shadows cast around the lamp either on the ground or on the buildings.

(4) The operating costs should be low and the efficiency as high as possible. These operating costs include current, cleaning and inspection, trimming, electrode costs and repairs.

(5) The initial cost should be low and this plays a doubly important part in the Great White Way lighting because the installation expense and maintenance is usually shared by the city, merchants, board of trade and lighting company. A fair method of distributing this expense is given in Baltimore, where the merchants and board of trade paid for the lamps and station equipment and the city pays so much per lamp per year for the maintenance. The lighting company supplied about $14,000 worth of cable and paid for laying it from the sub-station to the first lamp on each circuit.

Perhaps just a word as to the proper method of installing these lamps will not be amiss at this time.

No. 16.—Pole and Concrete Base.

The lamp, as you will see, is mounted on a standard, usually of cast iron, though sometimes of wood or reinforced sheet metal. This standard or pole is bolted to a concrete pier about 2 feet square and 30 inches deep. The underground feeder is usually lead covered cable run in iron conduit or fibre duct, or often a steel-armoured cable is laid bare in the ground. This is laid about 18 inches to 2 feet below the surface and is run along inside the curbing or direct from the nearest manhole as the case may be. The cable runs up as far as the absolute cutout located in the base of the pole. Twin conductor rubber-covered cable is run from the cutout to the lamp terminals. On top of the pole is a heavily glazed porcelain insulator which will stand 30,000 volt high potential and the lamp is mounted on this insulator.

No. 17.—Mechanism of Lamp.

Now let us consider the lamp itself. There is not a single new principle in the lamp. The electrical circuit is identical with the pendant type, of which there are approximately 150,000 in use on this continent to-day.

No. 18.—Connections.

You will note that the electrical connections are the same as with the pendant type of lamps—the current passing through the starting magnets and resistance and cutout. This brings the electrodes together and energizes the series cutout magnet which lifts the upper contact, cutting out the starting resistance and magnets. As the lower electrode burns away, the voltage across the arc rises. This increase in arc voltage energizes the shunt cutout coil which raises its armature and cuts out the lamp, thereby obtaining a new feed.

No. 19.—Forms 10 and 6.

Here you see the two lamps put side by side and between them are the parts which are interchangeable. You will notice all the magnets, cutouts, resistances, etc., which form the electrical circuit are interchangeable. We have simply put the arc above the mechanism and made only such changes as were mechanically necessary to bring about this condition.

No. 20.—Lamp on Pole.

This shows the lamp mounted on a pole. You will note the top ornament, globe casing, insulator and form of design which is particularly pleasing to the eye.

No. 21.—Trimming Operation.

This illustrates how easy it is to trim the lamp. The top ornament, upper globe seat and electrode box are raised and turned through an angle of 180 degrees. This automatically locks to prevent accidental falling. The spent electrode is removed and a new one is inserted. The new electrode is then tripped into position.

No. 22.—Cleaning Operation.

It is now a simple matter to remove the ashpan and wipe the globe. You will note that during the trimming and cleaning, it is unnecessary to remove the globe from the lamp.

No. 23.—Sectional Drawing.

This is a sectional view of the lamp. The lower guide tube is shown below and the lower electrode holder is fastened to this by means of a long extra flexible braided copper conductor. Sliding contact is not depended upon. Above, the upper electrode is mounted in the electrode box and the fumes go up the chimney and out through an opening in the top ornament.

No. 24.—Pole Manufacturing Drawing.

This Company does not make standards for these lamps but submit drawings similar to this one to various pole manufacturers and furnish them with any data they desire, and in fact co-operate as far as possible to produce a unit of harmonious design as well as a perfect lamp from an operating point of view.

No. 25.—Three Casings.

The artistic eye varies considerably, and in order to allow our customers to select their own designs, three casings have been standardized. These photographs and drawings of the lamps have been sent to pole manufacturers and they will co-operate with you in designing a suitable standard for the lamps.

Maintenance.

Now let us consider what it costs to run a system of this kind. Below is given the maintenance and data of these lamps. These figures are conservative and actual installations will conform closely to same.

DATA.	Form 10	Form 12	Form 14
Amperes	6.6	4	4
Volts	78-83	80-85	80-85
Watts	532	330	330
Rectifier efficiency	92	92	92
Per cent line loss	5	5	5
Watts at switchboard	607	377	377
K.W. hrs. per lamp year (4000 hrs).	2428	1508	1508
Life upper electrode	2-4000	6-8000	6-8000
Life lower electrode	100-125	125-150	250-300

MAINTENANCE.			
Energy at $.01 per K.W. Hr.	$24.28	$15.08	$15.08
Cost of upper electrodes	1.37	.48	.48
Cost of lower electrodes	4.48	3.78	1.96
Cost of inspection and trimming	1.82	1.48	.73
Cost of globes	3.20	2.40	3.00
Cost of rectifier tubes	2.40	2.40	2.40
Repairs	.75	.75	.75
Total maintenance, 4000 hours	$38.30	$26.37	$24.40
Total maintenance, 2000 hours	19.15	13.19	12.20

DATA	Form 6, 6.6 amp. Pendant type	Form 3, 4 amp. Pendant type.
Amperes	6.6	4
Volts	75-80	75-80
Watts	510	310
Rectifier efficiency	92	92
Per cent line loss	5	5
Watts at switchboard	582	353
K.W. hrs. per lamp year (4000 hours)	2328	1412
Life upper electrode	2-4000	6-8000
Life lower electrode	100-125	175-200
MAINTENANCE.		
Energy at $.01 per K.W. Hr.	$23.28	$14.12
Cost of upper electrodes	1.37	.48
Cost of lower electrodes	3.04	1.55
Cost of inspection and trimming	1.82	1.10
Cost of globes	1.00	1.00
Cost of rectifier tubes	2.40	2.40
Repairs	.40	.40
Total maintenance, 4000 hours	$33.31	$21.05
Total maintenance, 2000 hours	16.65	10.53

Method of Installation.

Let us consider, briefly, the methods of installing these lamps. There are only two methods which may be used, viz.: poles, brackets.

No. 26.—Rochester Pole.

This is a standard which was designed for the Rochester Gas and Electric Company and nearly five hundred of these have been ordered. You will notice that the top ornament, globe, casing and pole present an artistic appearance.

No. 27.—Brantford Standard.

Here we have the standard which was designed by the Ornamental Lighting Pole Co., for the City of Brantford, 152 of which will be installed.

No. 28.—Bracket (Ornamental Lighting Pole Co.)

Here we have a bracket attached to an ordinary iron trolley pole. Space is provided in the bracket for the reception of the cut out. The portion of the bracket below the arm encloses the lower guide tube of the lamp and enhances the appearance by giving the torchlight effect. This bracket may be clamped to any standard trolly pole, and is designed with an adjustable joint so that the lamp may be set vertical where poles are set at a rake.

This combination is also very pleasing to the eye and is one that may be adopted for two reasons.

(1) It is usually cheaper, since the brackets are cheaper than poles, and

(2) Many cities object to having too many poles on the street and so attach brackets to their existing trolley poles.

This same bracket, with slight modification, may be used for attaching to concrete or wooden poles, also to flat surfaces such as the walls of a building.

No. 29.—Lundin Bracket.

This is a simple bracket of the Lundin Company and is shown to give you some idea of the various designs.

No. 30.—Double Bracket.

For large areas such as city squares, for example, the City Hall Square, Lynn, Mass., Coply Square, Boston, Mass., where a great quantity of light is wanted, a pole similar to this can be used. It permits of the use of two lamps and at the same time presents a neat appearance.

Installations.

Let us now consider a few installations and see how the effect desired is obtained.

No. 31.—Enclosed Arcs, Genesee Street, Utica, N.Y.

Here is a street in Utica, N.Y., until a few months ago lighted by enclosed arc lamps. You will note the inability to discern the roof tops, and in fact nothing much can be seen but arc lamps.

No. 32.—Genesee St., Utica, N.Y. (Day).

No. 33.—Genesee St., Utica, N.Y. (Night).

Here is Genesee Street, in Utica, lighted by Form 10 ornamental luminous arc lamps. Notice the detail on the street surface and the buildings shown in bright relief against a black skyline. You can easily read the Taft and Sherman sign.

No. 34.—Eutaw Street, Baltimore (Day).

Here is a day view of Eutaw Street, Baltimore. You can see the lamps down either side of the street. They are unobtrusive, yet highly ornamental.

No. 35—Eutaw St., Baltimore (Night).

By comparing this picture with the preceding one, you will see how nearly the Great White Way effect is obtained. The signs on Brager's store are easily readable, the street surface and buildings are evenly lighted and there is no glare.

No. 36.—Charles Street, Baltimore (Night).

Notice the details of architecture in the bank building on the right.

(Dickerson's Experience in Oklahoma.)

No. 37.—Chapel Street, New Haven, Conn.

This is a day view of Chapel Street. The appropriately designed standards, each with its single white globe, are discernible down both sides of the street—very attractive and not conspicuous enough to detract from its appearance and not spaced closely enough to be monotonous.

No. 38.—Same at Night.

Note the sign shown well though considerably above the light.

No. 39.—Church Street by Day.

No. 40.—Church Street by Night.

Note building tops.

No. 41.—Day and Night Views, Church Street.

Compare details by day and night.

No. 42.—Night View. Eighth Avenue, Calgary, Alta.

6.6 ampere Ornamental Luminous Arc Lamp, spacing ten lamps per block of 500 ft., street 66 ft. wide, sidewalk 10 ft. wide, arc 16 ft. 4 in. above pavement.

No. 43.—Night View. Eighth Avenue, Calgary, Alta.

Note the illumination of front of building, extending clear to top.

No. 44.—Eighth Avenue, Calgary, Alta.

Note the illumination of front of this building, as compared with that on the side.

THE PRESIDENT: We will not now have the discussion on this paper but will proceed with the next paper, and discuss the two of them together. Mr. T. J. Pace, Westinghouse Electric and Manufacturing Company, will read a paper, "Flame Carbon Arc Lamps."

FLAME CARBON ARC LAMPS

By T. J. Pace

Of the Westinghouse Electric & Mfg. Co.

(1) For some time past the need of more light has been realized by nearly every growing energetic community. The comfort and safety of night travel, the improved appearance of buildings and streets, the impetus given to business, and the added sources of recreation, resulting from the thorough lighting of streets, boulevards, buildings and parks, has claimed the attention of the public and assures the continued interest and support in the future illumination developments. But a few years ago large areas were lighted by enclosed arc lamps. These units gave excellent service and created occasion for the remark that "an arc light is the equivalent of a policeman." Following this appreciation of good illumination arc lamp development created, in the order named: a short burning flame carbon lamp, the metallic flame lamp, and finally the long-burning flame carbon lamp.

(2) In so far as high intensity of illumination was concerned, the short-burning flame carbon lamp was readily accepted, especially by industrial plants wherein work of a nature requiring a high degree of illumination was performed, as well as by public parks and amusement places, who desired to take advantage of the spectacular effect obtainable for display and advertising purposes. However, the short life of the carbon (approximately 15 hours) available at that time, requiring frequent trimming, together with the obtaining comparatively high cost of labor, naturally retarded the general adoption of this type of lamp on a large scale. During the transitionary period in which the short-burning lamp was developed into the long-burning lamp, the metallic flame arc lamp came into prominence. Although the latter lamp, sometimes called the luminous lamp, gives very desirable illumination both with respect to quantity and quality, especially when operated at 6.6 amperes, this type of lamp is inherently limited in its application as it must necessarily be confined to direct current circuits. This requires the use of rectifying apparatus, which for street lighting purposes is usually of the mercury vapor type. Using alternating current throughout, as in the A.C. series flame carbon arc lamp system, removes the expense incident to rectifier bulb renewals, improves the power factor considerably and naturally constitutes a more flexible system.

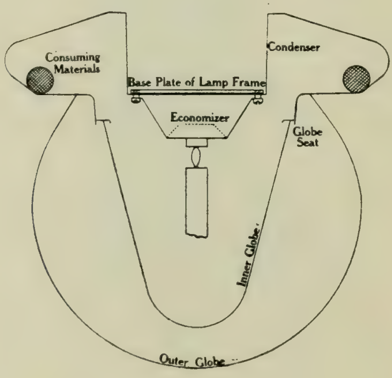
(3) To the very emphatic demand for more light in the business or more congested districts of the larger cities, as well as throughout the larger industrial plants, may be largely and safely attributed the commercial development of the long-burning flame carbon arc lamp, including, of course, carbons for use therewith. This required considerable work and expense on the part of the manufacturers involved, as it was necessary to eliminate certain troublesome features inherent in the short-burning lamp; principal among which was, first, to increase the carbon life in order to economize on the labor item maintenance; second, to satisfactorily and effectively

Fig. 1—One Hundred Hour Series Alternating-Current Flame Carbon Arc Lamp.

dispose of the fumes from the arc in order to maintain approximately uniform effective intensity throughout the trim, and third to simplify the lamp mechanism. It was an established fact that by placing a carbon arc in a suitable enclosure would result in a slower combustion and therefore an increase in the carbon life. However, while burning, the fumes from the arc condense in the form of a fine white powder on the globe in a very few hours to an extent sufficient to absorb an appreciable amount of light. Since a natural circulation of the arc fumes exists in the enclosure, incident to the use of a small enclosing globe, the objection cited was overcome by placing a cooling or condensing chamber immediately above the arc into which the fumes

are drawn, cooled and deposited on the inner surface, if not entirely absorbed by the magnesia or other alkaline material placed therein, which will readily combine with the hydro-floric acid, nitric acid, etc. preventing the free acids from attacking the globe,thereby decreasing its transparency and the amount of light emitted. The external appearance of a lamp designed to overcome the difficulties experienced with the short-burning flame type is shown in Fig. 1, and the lower portion of the lamp showing diagramatically the arc enclosure and condenser, just referred to, is represented by Fig. 2. This lamp will give a carbon life equivalent to that of the enclosed carbon lamp, that is, from 100 to 125 hours average per trim without serious depreciation in light intensity.

(4) By the use of suitable carbons a light of most any commercial color may be obtained. For street lighting purposes carbons giving a white light



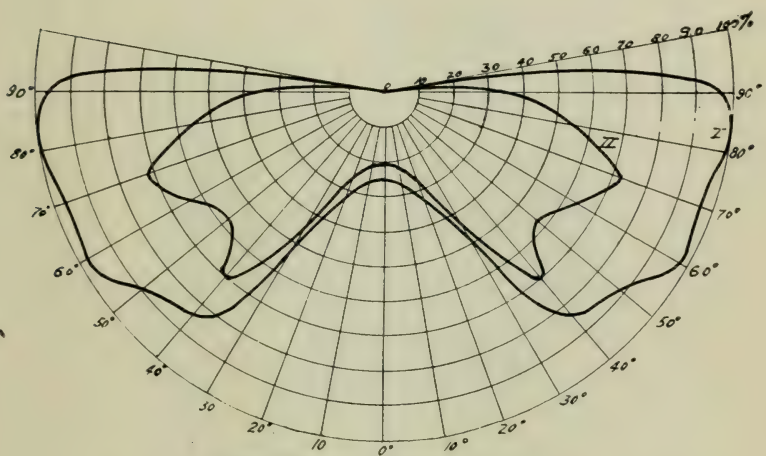
Fig, 2—Diagram of Globe, Arc Chamber and Condenser.

are quite universally used in the United States; the use of the yellow light carbons being confined almost entirely to display or industrial plant illumination. Yellow light carbons may be obtained which give from 30 to 50% more light than the white light carbons, and their use is therefore invaluable where dusty or smoky atmospheric conditions abound, and also on wharves and docks where a penetrating light is desirable to combat surrounding fog.

(5) The efficiency of the flame arc as an illuminant is particularly high. The mean low hemispherical candle power per watt varies from 2.5 with white carbons and Alba glassware to 5 mean lower hemisperical candle power per watt with clear glassware. When opalescent globes are employed

the efficiency falls between these values. In Fig. 3 are shown relative distribution curves of a 10 ampere, A.C. series, flame carbon lamp and a 6.6 ampere metallic flame lamp. Fig. 4 shows a comparative illumination in values of m.s.c.p., and m.l.h.c.p. of various types of present day commercial arc lamps. This figure emphasizes the decided light giving superiority of the flame carbon lamp.

(6). In the development of this form of lamp, the requirements of the central station together with those of the manufacturer and the public at



Comparative Distribution Curves

I-10 Ampere A.C. Series Flame Carbon Arc Lamp. (Clear Inner and Outer Globes, White Carbon.)

Terminal Volts 55		M.L.H.C.P 1400
Terminal Watts 445	Amperes......10	M.S.C.P 769
Arc Volts 49	Efficiency......88%	M.L.H.C.P Per Watt 3.14
Arc Watts......392	Power Factor 81%	M.S.C.P " " 1.72

II-6.6 Ampere D.C. Series Metallic Flame Arc Lamp (Clear Glassware)

Terminal Volts 68		M.L.H.C.P 920
Terminal Watts 449	Amperes.....6.6	M.S.C.P 462
Arc Volts 65.8	Efficiency 96%	M.L.H.C.P Per Watt 2.05
Arc Watts.......431		M.S.C.P " " 1.03

Fig 3

large have been very carefully analyzed and reduced to a concrete expression in the design of the lamp, as shown in Figures 1, 5 and 6. This powerful light unit combines economy and reliability of operation with a graceful and pleasing appearance. The operating temperatures have been kept low, the potential strains have been minimized, the margins of insulation are large, and the insulating material throughout is fireproof and weatherproof. The causes for the deterioration of alloys and metals, due mainly to corrosion caused by gaseous fumes and the weather, as well as the alternate expansion

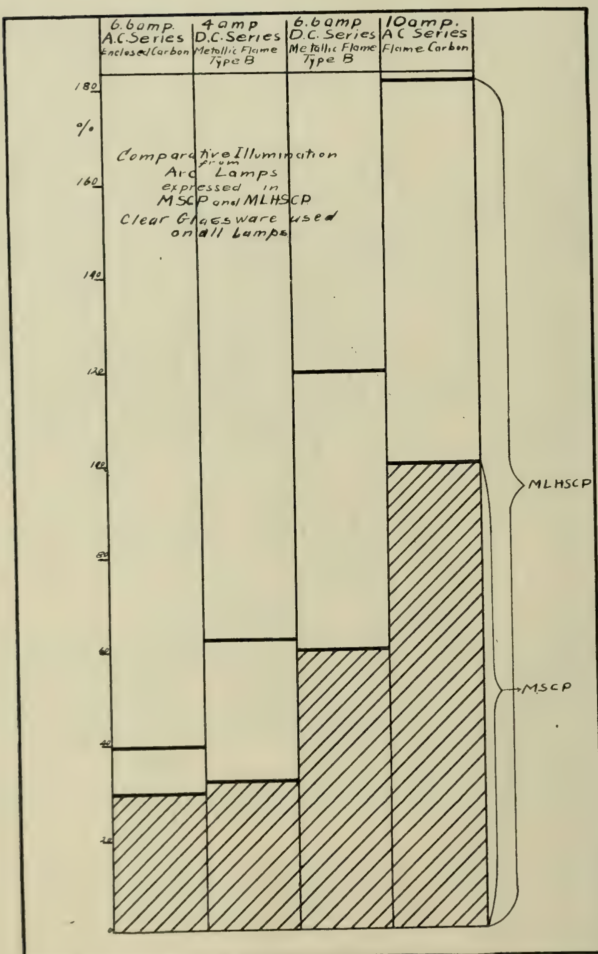

6.6amp. A.C.Series Enclosed Carbon
4amp D.C.Series Metallic Flame Type B
6.6amp D.C. Series Metallic Flame Type B
10amp. A C Series Flame Carbon
180
%
160
140
120
100
80
60
40
20
0
Comparative Illumination from Arc Lamps expressed in MSCP and MLHSCP
Clear Glassware used on all Lamps
MLHSCP
MSCP

Fig. 4.

and contraction, due to temperature changes which destroy the fibre of the metals has been zealously guarded against. Reference to Fig. 5 will at once make it apparent that the word "accessibility" was religiously kept in mind by the designing engineers. Any part of the lamp mechanism may be readily removed and replaced without removing the lamp from the circuit.

(7). Fig. 7 shows diagramatically one form of lamp mechanism designed to eliminate entirely sliding friction during the regulation of the lamp, while again Fig. 6 are photographic views of such a mechanism. It will be observed from Fig. 7 that the rocker arm N, which is pivoted at A,

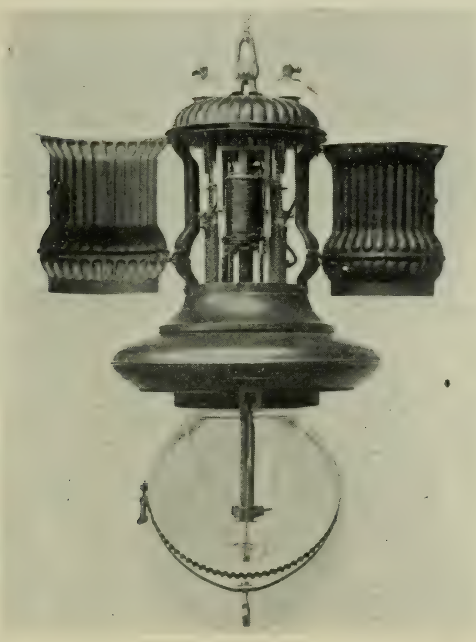


Fig. 5—A. C. series lamp with doors open, exposing mechanism and outer globe suspended.

carries the bearing for the chain wheels, E and F, the clutch rods, B, and the magnet cores, C and D. The chain wheel F, which carries the upper carbon holder is so placed that the chain O, which supports the upper carbon holder leaves the wheel in the same vertical plane that contains the clutch rod. Since the regulation of the lamp is accomplished by the movement of the rocker arm N, there will be no relative movement of the clutch rods and the chain which holds the upper carbon holder. If, therefore, the clutch rods are made the only guides of the upper carbon holder the sliding friction during regulation is eliminated. Coils, resistors and other parts essential to the lamp are distributed in such a manner as to readily radiate

the heat generated during operation. The series coils which carry the arc current are wound with asbestos covered wire. The resistors are made of a special wire which will not become brittle or granular in service, are wound on porcelain tubes and covered with a heat-resisting, durable, insulating cement. The clutch is made of tempered tool steel, having a thickness and diameter of hole of such dimensions that a positive grip is obtained on the carbons. The shell throughout, including the condensor, is made of a heavy gauge high grade copper. Its design is such as to not only give ready access to the lamp mechanism but also the maximum of strength. It is both weatherproof and insectproof.

(8). With the exception of the enclosed carbon lamp this long-burning

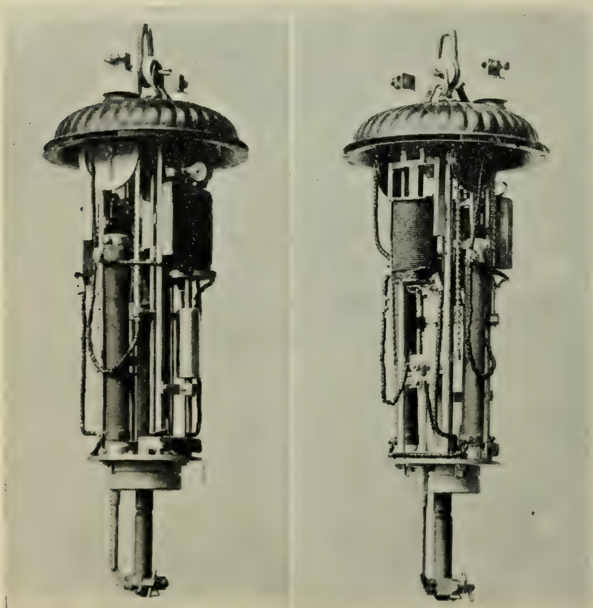
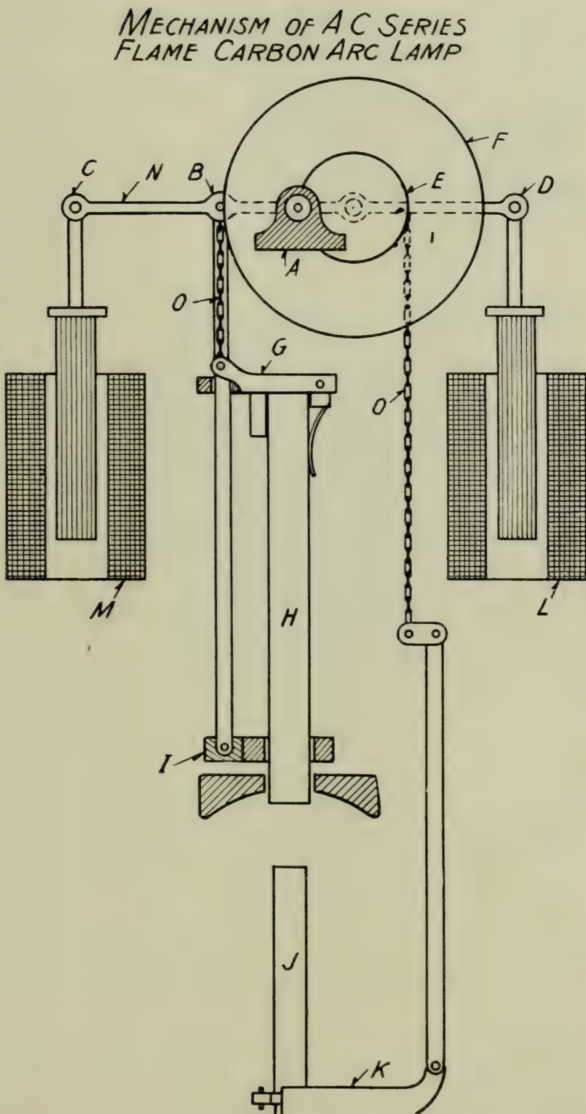


Fig 6.

lamp covers a wider range of application than any of its predecessors. It is designed to operate on series and multiple A.C.and D.C. circuits, and in multiple series on D.C. power circuits. By the use of a self-contained or external auto transformer, the latter is shown in Fig. 8, individual A.C. constant current lamps may be placed on an existing circuit of a different current value than that of the standard lamp. This scheme is frequently resorted to when it is desirable to increase the illumination at certain points, for instance, in the more prominent street or squares.

(9). Table 1 shows the approximate electrical performance of various standard flame carbon arc lamps.


MECHANISM OF A C SERIES
FLAME CARBON ARC LAMP
F
C
N
B
E
D
A
O
G
O
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K

Fig. 7

Table 1—ELECTRICAL CHARACTERISTICS OF FLAME CARBON ARC LAMPS.

Type of Lamp.	Terminal Watts.	Terminal Volts.	Arc Amperes.	Arc Volts.	Electrical Eff.—per cent.	Power. Factor
A-C. Series............	445	55	10	47	88.0	82
A-C Multiple..........	445	100 to 120	10	45	81.0	61
D-C Multiple.........	715	100 to 120	6.5	70	63.6	..
D.C Multiple—Series..	715	100 to 120	6.5	70	63.6	..

(10). The D.C. multiple series lamps are usually used two on 110 or 220 volt circuits, or five on 550 volt circuits.

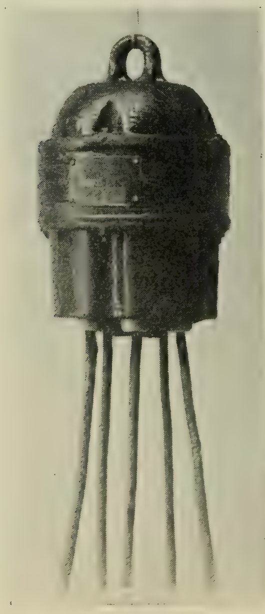


Fig. 8—Series Auto-Transformer for Burning Ten Ampere Lamps on a 6.6 or 7.5 Ampere Series Circuit.

(11). Perhaps the most interesting application of this particular form of lamp is to low frequency circuits of 25 cycles and upward. Many industrial plants having low frequency power-circuits only available desired a satisfactory large candle power unit, and have heretofore been obliged to confine themselves to the use of Tungsten lamps, oftentimes inefficiently located with reference to height, or with the flickering light of 25 cycle enclosed carbon arc lamp. Since the light of an unimpregnated carbon arc

is emitted from the positive crater the source shifts continually from upper to lower carbon with each reversal of current, and as this results in giving alternately a downward and an upward illumination, the light variation at this low frequency is very marked. In the flame or impregnated carbon arc the light is obtained from the arc stream and is, therefore, independent of the polarity. There is, of course, a slight decrease of light at each reversal of current, due to cooling of the arc gases. This, however, is not considered objectionable under ordinary conditions, for instance, in an industrial plant where the workmen are not called upon to perform work of a nature requiring extreme accuracy of vision. The high power factor of the flame arc is due to the ease with which the current is re-established through the hot gases after each reversal of current, and since the light flux is largely dependent upon the current it is evident that the least variation or flicker in the light will be found in the arc of highest power factor. Users of 25 cycle, flame carbon arc lamps, having considerable experience with other illuminants on this frequency, have expressed themselves as being pleasantly surprised with the electrical operation of the lamp and the character of illumination obtained. Inasmuch as the requirements for street lighting purposes are perhaps not so critical with reference to steadiness as for industrial plant illumination, it is predicted that the long-burning flame carbon lamp will be freely used on low frequency circuits for street lighting.

(12). At the present time many industrial plants are equipped with the short-burning flame carbon lamps.

(13). Table 2 shows an estimated comparison of the carbon and trimming costs of the short and long burning flame carbon lamps.

Table 2.

ELECTRODE AND TRIMMING EXPENSE FOR (A) SHORT AND (B) LONG BURNING FLAME CARBON ARC LAMPS.

	A.	B.
Hours life per trim	15	110
Cost of carbons per trim	\$ 0.17	\$ 0.17
Carbon cost per year (4000 hours)	45.90	6.18
Labor of trimming, at 4c. per trim	10.70	1.60
Total	\$56.60	\$ 7.78

(14). In addition to the marked saving indicated by the use of the latter type, there should also be considered the cost of the time saved in a great many plants, due to the less frequent suspension of work in order to retrim the lamps.

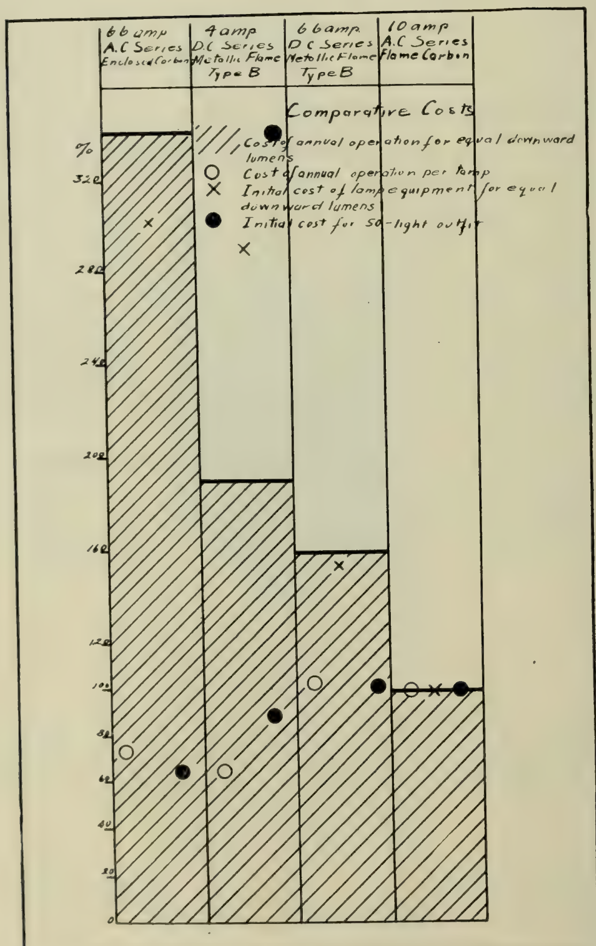

6.6 amp A.C. Series Enclosed Carbon
4 amp D.C. Series Metallic Flame Type B
6.6 amp. D.C. Series Metallic Flame Type B
10 amp A.C. Series Flame Carbon
Comparative Costs
Cost of annual operation for equal downward lumens
Cost of annual operation per lamp
Initial cost of lamp equipment for equal downward lumens
Initial cost for 50-light outfit
%
320
280
240
200
160
120
100
80
60
40
20
0

Fig. 9

(15). Table 3 gives a tabulation of estimated relative operating costs per year of 4000 hours for various lamps used to-day for street lighting purposes.

	A.C. Ser. Enclosed Carbon Lamp	Metallic Flame Lamp	Metallic Flame Lamp	Flame Carbon Series Lamp
Current at terminals	6.6	4.	6.6	10.
Volts at terminals	76.	68.	68.	55.
Watts at terminals	411.	272.	449.	445.
Regulator efficiency (50-Lt. outfit)	96%	91.7%	91.3%	96%
Watts at bus bars, exclud. line loss	428.	296.	492.	463.
Power cost per year of 4000 hours at 1c. per KW Hour	$17.12	$11.84	$19.70	$ 18.50
Hours life per trim	90	250	115	110
Carbon cost per trim	$ .021	$ .10	$ .12	$ .17
Carbon cost per year	.93	1.60	4.18	6.18
Labor of trimming 4c. per trim	1.78	.64	1.39	1.46
Repairs	.60	.60	.60	.60
Glassware	.53	.35	.35	.60
Consumer material	....	....	....	1.40
Rectifier bulbs per lamp per year	....	3.76	3.76	....
Interest 4% and Depreciation 10%	4.46	5.70	6.57	6.49
Total Annual Operating Costs	$25.42	$24.49	$36.55	$35.23

(16). Items of cost common to all types of lamps have been omitted. Maintenance, including such items as repairs and glassware differ in various localities, and therefore reasonable average values have been used. It will be observed that the item of interest and depreciation includes the costs, etc., of the station apparatus required in each case to take care of 50 lamps.

(17). Approximate, initial and comparative annual operating costs are given in Fig. 9 for the various systems on a lamp, per lamp basis, and also on the different systems based on equal downward lumens. It should, of course, be kept in mind that certain items in these total cost figures with respect to each class of lamp will vary, depending upon local conditions, but it is believed that the relative estimated cost figures are reasonably accurate, especially from a comparative standpoint.

(18). Inasmuch as the trend of improvement in arc lamp development has been constantly toward a lamp that will give maximum useful light at a minimum cost, that will be simple in operation, reliable and positive in action, and the fact that this type of lamp has been adopted by some of the larger and more representative central stations and municipalities, leads to the conclusion that we may look forward to it being placed in service in large numbers from this time on.

DISCUSSION.

Mr. Pace gave a lantern slide exhibition of flame carbon arc lamps.

THE PRESIDENT: Owing to the limited time at our disposal for the purposes of discussion, we propose to combine the discussion on these two papers. These papers are now open for discussion.

MR. A. L. MUDGE: Both of the papers just read, I think, are very opportune at the present moment on account of the strong general demand for better illumination, particularly in the business parts of the city. This demand, I think, has arisen mainly during the last three or four years. For the business section of a city, where a fairly intense illumination is desired both of the surface of the streets and for the surrounding buildings, a lamp of the make just described, that is, either a flame carbon arc or magnetite arc lamp, seems to give decidedly better results than five light Tungsten clusters. I believe that a good many of the Tungsten clusters that are already up in the business sections of our cities will be replaced before very long by one or other of the improved types of arc lamps. The Tungsten lamp has its field in street lighting in the residential parts of the cities, and also in the smaller towns and outlying districts.

Mr. Burpee spoke about the installation at Calgary. I was fortunate enough to see that installation a few months ago and it certainly was very interesting. On 8th Avenue, which is the main business street of Calgary, the 6.6 magnetite lamps of the inverted type, as shown in one of the photographs thrown on the screen, are on every trolley pole, that is, 110 feet apart on both sides of the street. As I remember it, they were about 17 or 18 feet from the ground. They give a very, very satisfactory illumination of the street, both the surface of the street and also of the buildings. And a very good comparison can be made with the cluster lighting, as on 7th Avenue, Calgary, that is the street on which the C.P.R. Station and new C.P.R. Hotel are located, is illuminated by the five light Tungsten cluster and there are also a number of five light clusters around the City Hall. The popular feeling in Calgary after seeing both types of illumination is much in favor of the arc lamp.

In the residential districts of Calgary there are a large number of magnetite lamps from 300 to 600 feet apart. They are of the standard type and are hung somewhat higher than the inverted type on 8th Avenue. They seem to give quite satisfactory results, that being partly due to the fact that there are practically no trees in Calgary.

One very striking thing about the photographs that were thrown on the screen, I think, was the good illumination of the buildings on the streets lighted. I do not know whether that is going to make big inroads into the sign business or not, but it seems to me electric signs won't be nearly as necessary if the buildings are well lighted up to the top.

MR. HILLMAN, New York: I happened to be in New Haven a number of times when the installation of the ornamental lights was first made, and I can say that a street was never lighted more beautifully in the world than Chapel Street at New Haven, with something like 90 to 100 or 110

of those magnetite ornamental posts. The question of decrease in the sign business is a very small one compared with the high degree of satisfaction which the ornamental pole illumination has given. The Central Station not only secured an excellent contract in connection with the illumination, but there was a hearty degree of co-operation exercised all along the line between Central Station and all the merchants, each one sharing in the expense, which is now a common method of conducting that character of street illumination. That hearty co-operation and goodwill which the Central Station secured through these ornamental lamps is worth a great many thousand dollars of sign-lighting business.

The point in reference to the illumination of the tops of the buildings is well taken. I have seen many photographs of the cornices on new buildings there at New Haven, and the illumination in a very nice way brought out the architectural designs of the buildings fully as much as in the daytime—in fact, I can imagine to a greater degree than the daytime, because of the location of that street. The sun coming up early in the morning and projecting its maximum light down the street, and then passing around, so that the remainder of the day there would be considerable shadow. I think that the ornamental artificial lighting would actually furnish a higher degree of uniformity than daylight.

One other point I would like to bring out in connection with magnetite arc in general. It is a good thing for Central Station managers to know that anything that they sell has been thoroughly well designed. It makes little difference whether you are selling shoes or clothes or soap or electricity, if the article which you are endeavoring to sell possesses great merit; then it is thoroughly competent to do the work, produces large sales and a prosperous business. Now, the magnetite arc development was commenced about thirteen or fourteen years ago. It seemed at first that it would be an easy matter to simply change about the interior design of the lamp, that it would have an outer casing the same as the enclosed arcs, and perhaps a year would suffice to bring out the electrodes. The first thing that was particularly noticeable was the brilliancy of the arc; for the same energy it would give several times the volume of illumination, and it would give maximum illumination in a horizontal direction. The arc itself was long and fat.

About a year was spent in connection with the feature of brilliancy, and about that time the Nernst lamp came out, when the question was raised about the character of the light, its spectrum and exactly what kind of a light should be used on the streets. It was finally decided to use as pure a white light as it was possible to secure, and so another year was taken to get both brilliancy and the proper spectroscopic character of the arc. Then on top of that came the absolute necessity for long life—if necessary, at least 80 or 100, perhaps 150, hours, and later, as it turned out, something like 200 hours was the life of the lamp.

But in striving for the life they lost out on brilliancy, as well as the character of the arc. After three years, they seemed to have the brilliancy and the character of the arc, also the long life, but it was at the expense of steadiness; it seemed to sputter and flicker more than a lamp should do that was going out to Central Stations for commercial service. Then

another year was taken to get all of those four requirements together—brilliancy, a long life, the steadiness and white character of the arc.

But there was still a fifth point, and that was the cost of the electrodes. They cost something like three to four times as much as the selling price that was established. Thus the manufacturer sent out into commercial service this arc lamp, which had been under development five or six years, with electrodes at a price that they thought the business would bear, which was one-third to one-fourth of the factory cost of the electrodes at that time.

I like to emphasize the point that probably there is no other article in the Central Station business that was more fully developed before it came to the Central Station than the magnetite arc. (Applause.)

Mr. T. J. Pace: In connection with the very excellent paper submitted by Mr. Burpee on Magnetite Street Lighting, there are a few points on which I should like to comment.

It should be made clear that the carbon electrodes referred to in the third paragraph of page 94 are of the unimpregnated type, and not the impregnated or flame type as used in flame carbon lamps.

Likewise, reference made in the fourth paragraph, same page, to the point from which most of the light emanates, applies to the arc between two plain or unimpregnated carbons as used in the open and enclosed arc lamps, rather than to the impregnated or flame carbon as used in the flame carbon arc lamp. In appearance, the flame carbon arc closely approaches the magnetite or metallic flame arc. It consists of a long ill-defined flame, which is intensely luminous and is terminated with a bright point at each end. These characteristics apply to both the A.C. and D.C. flame carbon arc lamp, and it is difficult to distinguish one from the other.

With reference to the comparison of results obtained in a luminous lamp by reversing the relative positions of the negative and positive electrodes, as outlined on pages 95, 96 and 98, including figs. 1 and 2, there is considerable difference of opinion amongst designing and illuminating engineers. Instead of entering into a somewhat lengthy theoretical discussion on this point, I will simply refer those who are interested to an article on "Some Observations on the Metallic Arc," by G. M. Little, which appears in the February, 1912, issue of the *Electric Journal*. After all, what the operating men are interested in is reliability of operation with minimum of maintenance cost, and it is perhaps sufficient to say that you have right here in Canada, thousands of lamps equipped with an upper negative electrode successfully operating from the view points indicated. It is true that increasing the diameter of an electrode has a tendency to keep the arc comparatively cool, but it is also true by virtue of the same fact, that it not only gives you a less intensive light source, but a greater area over which the arc may travel and therefore increases the instability of the arc.

I was very much interested in the statement made by Mr. Hillman that the manufacturers had been furnishing magnetite electrodes considerably below the factory cost in order to encourage the use of this form of lamp. I was unaware of any such action, although it is true that the present prices are not in excess of commercial costs. I am quite sure that the operating men and the members of this Association would be very much interested in

reading the report on the luminous arc system, particularly the station equipment as submitted by the Electrical Apparatus Committee at the last convention of the N.E.L.A.

In connection with the paper on Flame Carbon Lamps, there is one point that I should like to direct your attention to, and that is the inclusion in the cost items, as given on page 131, of "consumer material" to the amount of $1.46 per lamp per year. This was included merely because it is the present practice to use magnesia blocks or cylinders in the condensing chamber for the purpose, as indicated in the paper, of absorbing the acids thrown off, and thereby preventing them from attacking the glassware. It will be interesting to note that some of the carbon manufacturers assure us that with the flame carbons now available this consumer material, or magnesia, can be omitted without fear of globe etching. Should this prove true in practice, it will of course eliminate one item of maintenance cost on this class of lamp and thereby increase the gap or discrepancy between the total relative estimated cost figures given.

I was also very much interested and somewhat surprised, in learning through conversations with a number of the members present, that the action on the part of some of the larger Central Stations and Municipalities in the States, during the last eight or ten months, in adopting flame carbon lamps in preference to all other forms of illuminants for street lighting purposes; had not yet manifested itself here.

The President: I am sure after the last speaker's remarks we all appreciate some of the difficulties in introducing new features to the market.

I am very sorry that the limited time at our disposal does not permit of a longer discussion on the papers.

Mr. Maclachlan, Belleville: I may say to see a comparison between the magnetite arc and five light clusters, that Buffalo is the place to see it. You can stand at the corner of the Electric Building and look down two streets and see magnetite down one street, and five light cluster down the other. Last week I had the pleasure of going over to Buffalo, and one street struck me very much. The lamps were placed every 170 feet of roadway. The roadway is about 85 feet from curb to curb, and standing on the devil strip in line with the two lamps you could read a newspaper with the normal rays—that is, holding newspaper parallel to the ground.

Another fact that would impress one looking at the Telephone Building—I don't know the exact number of storeys; I counted sixteen—you can see the coping on the roof quite plainly.

One question I would like to ask Mr. Burpee—what he would consider would be the correct foot candles to use on the business street of a town of possibly 20,000 inhabitants?

Mr. Burpee: There are some conditions perhaps there. I would not like to give that answer right offhand; I could give it later.

Mr. Howe, Toronto: I would just like to mention the fact that illumination, that is, the high intense illumination on streets throwing it up on the buildings, has a disadvantage in the fact that on a lot of streets there are residences of which the second storeys are used by people for sleeping purposes. Therefore too much light is apt to interfere with that purpose. I would like to know if anything has been brought up to offset that?

THE PRESIDENT: I think one illustration in Mr. Burpee's paper shows the advantage of low horizontal lighting.

MR. HASTINGS: I think it is a pretty general fact that where these high intensity lamps are used the current is 60 cycles or D.C. I would just like to know what effect the rectified 25 cycle current has on the flickering of magnetite arcs?

MR. BURPEE: You cannot see it, because you have a total frequency in the direct current side. Twenty-five cycle gives 50 in the direct current side. When the rectifiers were first brought out and put in Baltimore, you could see a flicker, a 25-cycle flicker.

THE PRESIDENT: I am very sorry to have to limit any further discussion on these two papers. The Association owes a vote of thanks to the writers of these very valuable papers.

The next paper is "Electricity on the Farm," by John C. Parker, Mechanical and Electrical Engineer, Rochester Railway and Light Company. Mr. Parker has been on this Committee in very active work in the N.E.L.A.; Mr. Parker is a well-known authority on this subject.

ELECTRICITY ON THE FARM.

By John C. Parker
Mechanical and Electrical Engineer, Rochester Railway & Light Company.

The progressive central station company is always casting about for means to extend its off-peak load, and has naturally looked to the industrial side of the rural life as a field for extension. Unfortunately, a great deal of the publicity and advertising in this connection has made more or less of a joke of electricity on the farm. In spite of all this, the writer is firmly convinced that proper rational study of this line as real business will result in very advantageous extensions. So thoroughly is this the case that the writer's company has one man detailed to do nothing other than study the possibilities of farm application, and has authorized the expenditure of approximately $2,000 on demonstration installations.

It is bad military tactics to enter an engagement without reconnaissance of the strength of the enemy. It will therefore be well to measure the difficulties in the way of farm extension. In the first place, the average farm will have a bad load factor. This, aside from the relatively large transformer and distributing feeder investment, is not serious, since the business is seasonally and daily off the peak of both the generating and main transmission equipment. The second difficulty is that the density of business must of necessity be rather low, therefore entailing heavy distribution costs in proportion to the business secured. This difficulty can be best met by recognizing that there is no justification for the same quality of service either with regard to continuity or close regulation that is justified, and, in fact, imperative, in the urban territory. With the advent of inexpensive protective equipment, of bimetallic conductors which enable long spans, and of more dependable and cheaper high voltage transformers, it becomes possible to cut down the investment in the distributing system, and to go even to the use of steel conductors, using one conductor with a ground return for single phase primary distribution.

A very large obstacle has been the relatively high cost of farm installation. The farmer cannot be expected to install direct individual motor drive on the various farm machines when they are used not more than 15 to 30 minutes a day, if so long as that. The individual installations must take the form of rugged, absolutely simple equipment, capable of withstanding rough usage, and keeping in operating condition without close follow-up from the maintenance department. The equipments must be of a wide range of utility, so that the same investment may serve a multiplicity of uses.

The natural tendency is for the engineer to seek high technical excellence in equipment. This is good, if the technical excellence justifies itself economically. In the case of the farm installations, however, such is not

the case. I have in mind a table presented in the report of the Committee on Electricity on the Farm at the Chicago Convention of the National Electric Light Association, June 2nd, of this year, in which is shown the cost of operation, including interest, depreciation, and labor, together with the cost of the electricity at rates varying from one to ten cents per kilowatt-hour. Taking as an example the cutting of fodder by a machine having a capacity of two tons, we find, if the power is sold at five cents per kilowatt-hour and labor is paid for at fifteen cents per hour, the following distribution of costs on the farm where the tests were made:

Labor	18.6 per cent.
Depreciation and interest	55.2 per cent.
Energy	26.2 per cent.

Somewhat otherwise expressed, the total cost of using such a machine, including interest, depreciation, and labor, ranged from 31.4 cents per ton to 50 cents per ton, while the kilowatt-hour cost varied from one cent to ten cents. Now it is obvious from these figures that no great loss would be incurred by the user of the apparatus were the efficiency of the equipment to be very much lower, provided the investment cost could be brought down. The cost of energy, in other words, is the small end of the proposition.

In the case of a cream separator, the condition is even more striking, as the same range of rates varied the total cost per 100 pounds from 2.7 cents to 3 cents, while at 5 cents per kilowatt-hour energy cost was only 6.8 per cent. of the total cost of cream separating. Now it is clear that in such a case—and even more so with a smaller amount of business than was done on this particular farm—the farmer's interest would be best served and the central station company's interest would be best served by the use of the less expensive machinery using more energy, provided such cheaper equipment did not run up the labor cost and would stay on the job.

The writer is convinced that central station companies have been discouraged from going after this class of business very largely by the trade literature put out, and wishes to urge the central station companies not to use this class of literature in soliciting farm business. No good can come from showing the farmer a picture of a woman in the evening dress conventional to the social life of the city gazing pensively at a luminous radiator. That kind of literature has no point of contact in the farmer's life, nor in the life of the woman on the farm. On the contrary, it damns electric services as a luxury which can be afforded only by the very well-to-do. Equally unhappy is the literature that shows an electric washing machine grinding out the week's wash, while the woman of the house sits at her leisure and reads the Confessions of a Circuit Rider's Wife in some great weekly advertising medium. Bad though the condition is, it is the truth that the average farmer does not want the women folks to loaf, and such advertising keeps the women just so far from securing the living conditions that they should have.

If the central station man will stop to think of some of the impressions he has received from some of this literature, he will perhaps sympathize with the farmer's view. You know that when you have seen pictures of the electrified dairy with cement floors and concrete gutters at the stall

openings, and three or four farm laborers attired in the white wings uniform of the street cleaner, you have at least subconsciously said, "This has no interest for me. We don't have dairy farms of that sort in our territory."

The writer's quarrel goes further than with the mere character of such literature. Not only is it bad advertising, but it connotes rural electrification that does not mean business; it bespeaks a conviction that the farms must be electrified on sentiment rather than as industrial propositions. This is absolutely wrong. The farm extensions must be tackled just as we tackle any factory application of electricity. The farmer must be shown that he can make six dollars a year for every five dollars of annual expenditure and this beyond the peradventure of a doubt.

It is a little early in the day to say yet what results can be secured in field farming from irrigation, but we do know that we can show the farmer tremendous opportunity for enlarging his crop, improving the quality, and insuring yield in the off years when market prices are high by the application of electrically pumped water to his truck and orchard ground. Even the famous Canadian apples can be brought to a higher state of perfection with regulated irrigation with proper power spraying and with closer attention to the matter of cultivation, hand-picking, and packing than when Nature is left to do her own unaided best.

It is in a sense unfortunate that the eastern territory has been so blessed by nature that artificial aids to farming have not been an absolute essential to existence, since this fact has perhaps prevented farmers from realizing how much they could do to augment their natural blessings. In the regions of the far West where irrigation, cultivation, and intensive methods of marketing have been necessary, results have been reached in the face of natural obstacles that discount tremendously what the eastern country has been able to do with all its natural advantages.

The writer is firmly assured that the time is not far distant when economic necessities will force intensive methods of production in this eastern country, opening up a wide field for irrigation in connection with even the coarser crops, and believes that the central station men can advantageously study the possibilities and arrange for demonstrations in their own territories.

To do this they will have to know as much about the farmer's business as they do about electricity, and will have to show him the possibilities attendant on various improvements that he can make in his methods of agriculture.

It has been demonstrated, for instance, season after season, that in certain parts of Pennsylvania irrigation of hay crops pays tremendously, but it is noteworthy that this irrigation has been profitable only where strong stands of hay could be secured. Again it is worthy of note that in what is known as the "new culture" of celery the plants are set three times as close as in the older methods, and of course require a great deal of irrigation to bring them on quickly. But in the case of either of these examples it is obvious that water alone won't do the job. The water is merely a solvent for bringing plant forming material from the ground, and therefore strong fertilization of the ground is absolutely necessary to supply the food for the closely planted crops.

The point is that in order to make a field for irrigation work, the central station man must develop the importance of close planting and fertilization in such cases as those just instanced. He must go into the other man's business enough to insure the benefits from the irrigation from which he hopes to receive an opportunity for power sale.

This matter of power supply for irrigation purposes is perhaps the most attractive among the opportunities for electrification in the rural districts. Judging by the reports made by the United States Federal Government, there can be no doubt about its being profitable for garden truck. There is little doubt that it pays the farmer well in his berry patches and orchards, and the indications are that a considerable field is opened up for irrigation of the coarser crops, provided proper sowings are made and fertilization is used.

Perhaps one difficulty in making farm extensions has been the fact that the central station has been too much in the habit of trying to supplant other forms of power by electric power, rather than using electric power as a means of saving wastage. When the barb wire fence of unsavory memory supplanted the snake fence, it was not alone the relative cost of steel and wood that determined the supersession of the old Virginia creeper, but the fact that the more picturesque construction took up a more considerable amount of land. So it must be with the electrification of the farms. It is not that the electric motor will develop more energy at $1.50 per day than will the farm laborer, but that the electric motor can be induced to stay on the farm and to be ready for work when it is wanted, while the farm laborer cannot. I believe that this must be the key-note in the "energizing" of our farms, if I may use the term. Year by year the matter of securing even indifferent, unintelligent, or unskilled farm help becomes harder and harder, until to-day it is probably the worst problem confronting the farmer. The electric motor is not merely a device for supplanting man power, but for freeing the farmer from his dependence on the man at all. In other words, it will be—when it comes into its own—a means of the solution of one of the social problems of farm economics. Again, it is not a question merely of whether an electric traction plow and cultivator and seeder will cost less to run than will the horse-drawn machines, but whether it will help solve the labor problem, and whether it will make it unnecessary to leave a three foot path for the horses down the middle of every eight-foot stretch of valuable tilled land.

One other illustration of what the writer has in mind is a device which he has suggested and which is now under development for orchard pruning. Most of you are probably familiar with the method of felling trees by electricity. It is suggested that the same incandescent wire method be used for cutting off tree limbs and twigs. Now in connection with such a recommendation it is to be noted that the apparatus will undoubtedly cost more than a pruning saw, and that it will cost money to operate it. But, on the other hand, with such a device that can be operated without the use of a ladder, without the fussy process of undercutting the limb to prevent the bark from stripping, and in such a way that a man can see what he is doing before he gets into the middle of his job, that can trim close without leaving a stub, and that will itself cauterize the wound as it is made, the labor will

not only be lessened, but the results of the work materially improved. It is a matter, therefore, merely for demonstration to determine whether the improved quality of the work and the lightening of the labor whereby the orchardist is freed from the hired man problem will more than offset the expense.

The writer is absolutely convinced that very extensive applications of electricity can be made on a sound industrial and economic basis on the farm, and is convinced that the reason why these applications have not been made heretofore is that those most interested in making them—the central station men—have not in any individual territory enough at stake to warrant the development cost. The possible manufacturers, on the other hand, being interested in the sale of devices, and perhaps somewhat far afield from the ultimate user, have not seen the necessity for keeping down the first cost, and keeping up the number of applications that can be made of such devices, if, indeed, their very habit of thought in general has not been foreign to the type of design necessary for farm machinery.

From the foregoing it is pretty evident that we have not as yet arrived at any real data concerning farm electification. At the present time there are in existence a few isolated services where extra-urban lines serving trolley system or passing to villages from large city generating plants have traversed rich farming communities, and where the lines have been tapped for here and there a few isolated gentlemen farmers or truck growers; but in general the eastern territory, at least, has nothing to show in the way of real development.

It may be unsafe to reason from analogy, but the writer feels that in spite of the lack of present accomplishment, the industrial applications on the farm are in a good deal the same condition that the automobile industry was in 1900. I am not going to develop the simile, but simply to ask who in the country at that time foresaw the tremendous industry of ten years later.

If we, in the electric business, are going to develop a farming territory, we will have to have the courage of our conviction in just the same way we have had to do in building up motor load and the electric vehicle business. Some of the older men may recall the days when it was very seriously questioned whether electric service could be extended outside the central shopping districts on a commercially self-sustaining basis; and even the younger of us can recall the days when electric welding and motor-drive for ice-making were more or less absurdities, commercially speaking.

This farm business is going to be worth going after. We are going to find the means of increasing the density of business by getting farmers to use more energy electrically than they have ever thought of using in any other form, and we are going to build up a summer daylight load through this means. We may not do it in the next year or two, or even in the next decade; but we will do it the sooner when we combine our efforts to find the means of getting around the not insuperable obstacles.

The first thing that will have to be done is to break loose from some of our traditions in regard to line construction by making the lines that serve the farmers inexpensive through the use of small copper section, light structures, and inexpensive protective apparatus, sacrificing, if necessary, close-

ness of regulation, and to some degree perhaps, continuity of service. The overload capacity of transformers will have to be used and perhaps pushed to the limit.

The wiring installations on the farms themselves will have to be of the most inexpensive sort, and the whole equipment of such a nature that the farmer will not have to tie up a large sum of money for one isolated function. First cost is going to be the second consideration, the first being ruggedness and simplicity; and consistently with the first two, lowness of power consumption will stand third. There is only one way for the central station company to assure itself what can be done in the farm electrification, and that is to go ahead and do it on a demonstration basis at first—after studying the possibilities in the individual territories served, and then to follow up the demonstration with more extensive work. No specific statements as to possibilities can be made which will be of universal value; as to what business is practicable in one territory will prove to be entirely out of the question in another. Each Company will have to study its own territory, and should place on the problem a man who is big enough to realize the possibilities, sane enough to measure the difficulties, and patient enough to overcome obstacles. Once the work has been tackled along this line, results will come just as they have in every other line of pioneer central station development.

DISCUSSION.

The President: After hearing Mr. Parker's paper we all realize that Mr. Parker has put a great deal of endeavor, enthusiasm and thought into his work.

One feature which struck me personally was that the Central Station men have got to get a new factor—he wants an adaptability factor, so that he can get into farm life and get to the farmer's point of view.

Mr. Maclachlan, Belleville: We have started rural work. We have two lines started, and we are going along somewhat on the lines laid down by Mr. Parker in keeping the cost of the initial installation down. I think that possibly some of the men that are more closely in touch with the rural end of the work, possibly Mr. Peeling, could give some ideas along this line and possibly one or two others.

Mr. C. U. Peeling, Bowmanville: I must say that I appreciated Mr. Parker's paper very much. He brought out some very good points, and I think that probably the chief point is that we have got to go after the business to get the business. The business is there; the farmer does not know it, and I have concluded we do not know it. Mr. Parker has informed us that there is a lot more business to be had than I have dreamt of, and I think our trouble is—(it is the trouble with most electrical companies)—we do not know what there is to be got and we are afraid to invest sufficient money to get it.

We have a few lines running out into the rural districts, but the installations in most cases are small, running from 1 to about 5 h.p. I feel that the rates that our company has quoted are low, but we are not getting

sufficient business to really pay as yet. We will have to do as Mr. Parker suggests—that is, develop the business and get more.

His idea of pruning is a suggestion which apparently is new. I had never heard of it before, and it would likely use considerable current, and, as all other loads on the farm would be, it would be a daylight load.

In regard to irrigation, that is something I know nothing about. I would like to know more about it, and I guess the only way to learn is to read and study. The Central Station men and the farmers also in this district have seen or know nothing about irrigation. Mr. Parker suggests that that opens a very wide field for the sale of electric power, due to the fact that we are able to increase production. That being the case, we ought to be able to make use of that particular branch. I suppose the only way we will be able to do it is to have demonstration installations to show the farmers what can be done. That is going to take time.

I do not like to do as Mr. Maclachlan did, shove this discussion off on to someone else, but Mr. McClellan, another man of our company, is the man who has been dealing with the farmer. Mr. McClellan has been handling the farm business for our company for about a year, and he knows the farmer.

Mr. McClellan, Trenton Electric & Water Co., Toronto: I might say, gentlemen, that as representative of the Electric Power Company my experience in their territory may not be, as Mr. Parker says, suitable to other companies. The country and district supplied by this company is; in my estimation, admirably adapted for rural work. This undertaking was gone into and practically started about three years ago, and up to this date there have been a number of different ways in which we have tried to secure business along this line. In the first place, the unity plan was adopted whereby the people would supply poles and part of the material. But it was readily made plain to us that time was something to the farmer, and in a great many cases possibly the material that he would buy or supply would be inferior, and consequently that plan was abandoned. Next came the plan of a flat rate in a certain district. And this in that district did not meet with success. While simultaneously in another district a meter rate was adopted and proved a success.

Now, the last year or so flat rates have been gone into largely and the rural work has been on a much larger scale, the farmer has a guaranteed cost of what he is going to pay and the Central Station has a guaranteed revenue which they may derive. Also a number of devices in which this can be used will cost the farmer nothing extra for current and thereby greatly encourage him to adopt up-to-date appliances. The number of methods in which this can be utilized on the farm in this country will increase, as Mr. Parker says. The class of farming which we have here is largely mixed farming. In some parts of the country it is what we call intensive and in other parts extensive—that is, large farms running around three hundred acres. This class of business has proven to the company to be better and to be taken on much more freely. In fact, we have one line of possibly 12 miles, using about 75 h.p. with another of a like distance under contract for approximately 100 h.p. Of course one customer one the line in operation consumes possibly 25 h.p. and this for a chopping business. The company

have invariably found in constructing these lines it is bad business to construct the line before the business is secured. The farmers immediately become indifferent when current is passing their door and they usually wait, thinking it will become cheaper. This in a great many cases is the wrong way to go about this. The installations, as Mr. Parker says —and I agree with him—must be rugged and cheap and free from any extravagance. The installations as we have in our district, say from 1 to 4 h.p., cost approximately for 1 h.p. about $110. Understand me, gentlemen, that this is for a motor and wiring alone. This can be increased to possibly twice that by other appliances. The cost of a 2 h.p. installation would be approximately $175., 3 h.p. $225, and so on. Of course when one deals with milking machines and other apparatus of a similar cost these figures will be increased considerably.

Now, I don't know that there is anything else. The paper as read by Mr. Parker covers the thing very closely and his remarks about advertising seems to hit the nail about right; that is, advertising such as a farmer considers an extravagance. This advertising should be put in journals and papers that will reach the farmer. Not saying anything against the advertising such as they have already adopted, but increase it by the addition of this class of advertising. Possibly the Central Station man needs to read as much about this as the farmer does.

The President: I am sorry that the limited time at our disposal will not permit of any further discussion.

Mr. Phillips, Brockville: I would like to ask Mr. Parker if the trimming of trees on the street can be done profitably electrically. If they can demonstrate the advantage to the farmer to prune trees electrically, why not the power company do their own trimming on the streets electrically?

Mr. J. C. Parker: I do not know whether you got one point in connection with this tree pruning. Like most of the paper it is still in the future. The apparatus is now under development and I hope that by the end of the summer we will know something about what it can be produced for.

I think it is a pretty wholesome suggestion, and one ought to take his own medicine, and I confess with much shame that it had not occurred to me that an apple tree and maple tree are not particularly different. (Laughter.)

The President: If there is no further discussion, I wish to extend to Mr. Parker the very hearty vote of thanks of the Association for his able paper, and the time and trouble he has taken in coming to Toronto to read it.

I would like to take advantage of this opportunity to say to Dean Galbraith, of the Faculty of Toronto University, that the Association owes a deep debt of gratitude to Mr. Galbraith and the Faculty, for the facilities which they have extended to the Association, and I ask the members to respond in a whole-hearted manner by hand-clapping.

The members gave a very hearty response by way of hand-clapping.

Dean Galbraith: Mr. President, I hardly expected to be called upon to-day to do duty. I am sure the University feels that it is doing only what is right in encouraging our Canadian Electrical Association in every possible

way, and I hope that we shall have you here for many sessions, that you will make up your minds to come here every year—that is, when you meet in Toronto. (Laughter.)

Now, I know that your programme is filled, and I shall not keep you. I conclude by again assuring you of the pleasure that we have in your meeting in Toronto and selecting the University as your meeting place. (Applause.)

The President: The afternoon session will be at 3.30 o'clock, when we will have the baseball match. It is very important that all the members should get there. We want all the ladies and gentlemen present for the photograph.

One of the questions that the Association has had up, as you are aware, is about the great many members who are not members of the parent Association, and who are here as guests to-day.

One of the features open to discussion is how best to promote the advancement of the Electrical industry, and incidentally the consideration of the Association's work. There have been a great many opinions expressed. They seem so diverse that it is hard to reconcile and get together on common ground. However, we would like not only the members but our guests and those who have registered in the regular way to speak frankly and freely as to just how they view this question. And in introducing this I would ask Mr. Young to read a report. About two months ago, in the month of April, the *Electrical News* sent out inquiries all over the country to get the different points of view as to just how they view this question, and I would ask Mr. Young to read the synopsis that he got as a result of that call.

Mr. T. S. Young, Toronto: Mr. President and Gentlemen—As has been explained by the President, at a meeting of the Managing Committee held in April I was asked to send out, in the name of the *Electrical News*, a number of letters to electrical men throughout Canada. Upwards of 1,000 letters were sent out from various selected lists. The replies are not as numerous as we anticipated, owing chiefly to the fact that it was impossible, without going into a great deal of detail, to make the letter just as definite and plain as it might have been made. The replies have been tabulated according to the business in which the person is engaged. I would like to just emphasize that where I refer to privately owned central stations, so many replies, that means from representatives of private stations, should not be regarded in favor of re-organization as 41 central stations. That does not mean exactly 41 central stations; it means 41 replies from representatives of central stations, individual replies.

REPLIES RECEIVED RE RE-ORGANIZATION OF CANADIAN ELECTRICAL ASSOCIATION ON BROADER LINES.

Privately Owned Central Stations.

In favor of re-organization	41
Against	14

Municipal Central Stations.

In favor of re-organization	35
Against	3

MANUFACTURERS.

In favor of re-organization	69
Against	11

CONSULTING ENGINEERS.

In favor of re-organization	13
Against	4

ELECTRICAL CONTRACTORS, ETC.

In favor of re-organization	15
Against	4

SUGGESTIONS.

PRIVATE CENTRAL STATIONS.

1. Should include engineering, operating, manufacturing and educational —without distinction as to municipal or otherwise.

2. Suggest that it be a Canadian association, with management entirely in Canada.

3. Association in general should be divided into two classes—manuturers and operators.

4. All members be required to furnish proof of electrical knowledge.

5. Shut out no one actually engaged in electrical work.

6. If possible retain affiliation with the N.E.L.A.

7. That the Association take in men actively engaged in electrical work, but not aldermen, commissioners, or chairmen of committees.

8. Do not feel the need of such an Association, being a member of the A.I.E.E. and having the privileges of the N.E.L.A.

9. Cannot see any real advantage to be gained except at expense of existing societies.

10. Am a member of the Canadian Street Railway Association, and do not believe another association for railways is required.

11. Would join if the municipal owned plants were excepted.

12. Canadian Electrical Association was started on "broad lines," but was not a success and had to be narrowed down.

13. No; Canadian Electrical Association broad enough.

14. Think there should be some way of keeping those out of the electrical business who do not know the difference between a volt and an ampere.

15. The association desired seems to be practically the old C.E.A. before affiliation with the N.E.L.A. I believe there is great need for some such organization, as at present many men are shut out from any active part in an electrical body. The N.E.L.A. conditions of membership are altogether too exclusive for the rank and file of electrical men in Canada. Personally, I feel that the question of affiliation was never properly dealt with, that the old C.E.A. members generally never had a proper opportunity to consider or pass upon the question.

16. I believe the idea is a good one, and do not see any substantial reason why the same could not be organized and maintained successfully. I would also be in favor of operating companies and officials of municipalities, who

are operating their own lighting and power systems, having memberships. The suggestion appeals quite strongly to the national spirit, and no trouble would be encountered in organizing such, but I believe it would be quite a task to administer the affairs of the Association in such a way as to keep it up-to-date and thoroughly progressive, so that each individual member and member company would be substantially benefited. The cost of maintaining a thoroughly efficient head office organization must be great, and unless this is done at the start and members are thoroughly convinced that they are connected with a real live organization, the result will be disappointing. We have seen this occur on several occasions. The efficiency of the organization will entirely depend upon the method in which the administration of the affairs are conducted, and great care should be taken at the start to insure the ultimate success of the venture.

MUNICIPAL CENTRAL STATIONS.

17. Suggest the formation of local branches.

18. Should include operating companies, electrical manufacturers, and electrical workers.

19. Yes, if you can include the countryman and give him value for his money. I dropped the A.I.E.E. because of not being able to attend meetings and meet engineers personally.

20. Yes, if the West is given due consideration. Believe that in a short time a Western association will be formed. Distance makes attendance at Eastern conventions impossible for those living west of the Great Lakes.

21. Get it going as quickly as possible.

22. Employees of municipalities should have same standing as employees of private corporations.

23. I think that the Canadian Electrical Association as originally conducted is what is required.

24. Should be open to every person engaged directly in the electrical business.

25. If each and every member of the proposed association is placed upon an equal footing regarding all matters, voting at election of officers, committee work, etc., I would fall in with the suggestion and my co-commissioners would no doubt join also.

26. I would recommend that candidates for membership be admitted only after having passed a thorough examination, and that a high standard of efficiency be set up by the association.

MANUFACTURERS.

27. We already have the A.I.E.E., the Canadian Electrical Association, the Sons of Jove, the Engineers' Club, etc., and further associations of electrical men seem somewhat redundant.

28. Would suggest that the West be better looked after than in the past and so get away from the idea that it is only an Eastern association.

29. That the Association include representatives of municipal plants.

30. Make an electrical contractors' section in the Association.

31. It should include firms like ourselves, who are not directly engaged in the electrical business, but have often to co-operate with the manufacturers.

32. Make it a Canadian association.

33. That a convention be held at Winnipeg.

34. Make it comprehensive.

35. That it be entirely a Canadian association and not influenced by affiliation with United States associations.

36. Broaden the Canadian Electrical Association instead of forming a new association.

37. It would be of too general a nature and would have to be sectionalized in order to be operated. Field is now well covered.

38. Should be on broad lines, including municipal as well as private concerns.

39. Executive committee and all officers should be elected by vote of total membership, irrespective of whether Central Station, manufacturer or other branch of business.

40. Organize it on general lines of the old Association, giving paramount attention to Canadian affairs—technical, manufacturing, etc.

41. That all members have a vote on election of officers, which the Canadian Electrical Association does not now permit.

42. Regain what was lost when Canadian Electrical Association affiliated with N.E.L.A.; form Western and Eastern sections.

43. The broadening out of this Association, in the writer's mind, would be a decided improvement, as under the present conditions it is simmered down to the local lighting company of the town wherever the convention is held, with a heavy percentage of manufacturers, jobbers and dealers. It seems to the writer that the Association should do something to get all the electric lighting companies represented at this Association by some means, whether they are companies, municipalities, or isolating plants, or parties associated with electric light and power companies in any way, in order to make the Association a success, as under the present conditions it seems to the writer it is far from being a success so far as a representative showing of parties interested in the electrical business is concerned.

44. At the present time there are seven or eight electrical associations, more or less prominent in Canada, such as the Canadian Electrical Association, Sons of Jove, National Electric Light Association and a number of others, who, if they carry out their work properly, cover practically every branch of the field, consequently it is hard to say at the moment what service would be performed by this new body.

45. After reading your letter and considering the matter from all angles, I am inclined to believe that the Association is wading out into rather deep water. I doubt very much if they would be successful in attempting to include all persons engaged in the electrical business in their membership. I also doubt if the rank and file would join the Association, for the reason that they have nothing to gain by so doing. In my opinion it would practically be impossible to induce them to attend the conventions, as you would have nothing to offer them, and, therefore, they would have no reason or excuse for attending. The only reason that the attendance at the Annual Conventions were as large as in the past was due to the presence of the Central Station men, who are the natural customers of most of the other members, and furnish the reason or excuse for their being present. At least this is so to a large extent, but I must not overlook the fact that a number of the mem-

bers attended the Convention for the reason that they were assured of a very pleasant time, due to the energy of the Entertainment Committee. The Jovian Order is doing in a very satisfactory manner what the Canadian Electrical Association would be attempting if they followed out the scheme of broadening the society to include all persons engaged in the electrical business. It seems to me that the present Association with the nucleus of Central Station members would do very well if they were not too ambitious, and would confine the bulk of their activities to this section of the country.

46. I would like to see the Canadian Electrical Association a purely Canadian organization, and run on broad lines to include all persons engaged in the electrical business. I am directly opposed to the present policy of the C.E. Association. If the majority of the members are not in favor of breaking away from the N.E.L.A., I would support a new association to include all persons engaged in the electrical business, and I would agree to the individual membership fee of $5.00 per year.

CONSULTING ENGINEERS.

47. The membership should be graded with certain qualifications for each grade.

48. The Association to have a central body, with branches in each province.

49. No, because we have the A.I.E.E., Canadian Society C.E., Jovian Order, etc., etc. Too much is enough, and one must neglect his duties if too much is assumed.

50. In view of existence of numerous associations, I regard such an Association to be unnecessary.

51. The grading of members, associates, etc., to be made by qualification and the constitution to be tightly drawn so that for all time the holding of membership with the Association would indicate the capacity for certain work.

52. The interests of persons engaged in the electrical business are too diversified to be covered by one association.

53. The Jovian Order meets the situation.

Respectfully submitted,

T. S. YOUNG.

THE PRESIDENT: Gentlemen, this question is now open for further discussion, and in asking Mr. Young to read a synopsis of the replies which he received, I thought it would indicate to the members how best to proceed. The question of how best to meet the needs is rather a difficult one for the Executive of the Association to decide upon. Practically the whole benefits to be derived from the Association are those derived by getting together at our Association meeting, reading papers, and by actual personal contact. To a great extent we have that advantage by just such meetings as we have to-day. We have papers from various members, irrespective of whether they belong to operating companies or municipalities or to the manufacturers, and if we accomplish that we have at least gone a long way.

I would like to ask Mr. Dion, of Ottawa, to start any discussion there is from the Central Station point of view. Mr. Dion was very closely identified with the Executive at the time of affiliation with the N.E.L.A.

Mr. A. A. Dion: I would have been better pleased, Mr. Chairman, if some other member had spoken first. I anticipate some objections will be raised by some of the members to the present organization, the manner of conducting it at present, and I was prepared rather to reply to those objections than to lead off in discussion. If any other member would like to speak.

The President: I would like very much to hear from some of the members who do not agree with the Constitution at present. The great difficulty is to get them to express their opinions. Unless they do, one cannot deal very well with this matter. It is the only way the Executive can arrive at an equitable decision. I would be very glad to hear from some of our guests or members on this matter. Is Mr. Abbott, of Winnipeg, here? Mr. Abbott is one who made a remark to me in the hotel rotunda yesterday. He said: "I do not believe in this Association; you never come West." One of the disadvantages is that we have always centralized around Eastern Canada. We offer no inducement to the Western members. Mr. Lambe, you get around the country.

Mr. Lambe, Ottawa: Mr. President, I scarcely know what to say on such short notice, and in the absence of any recommendation from the Executive Committee. I understand though that something has to be done as far as finances are concerned, it apparently being next to impossible to carry on the Association on the present fee. Then, as far as membership is concerned, I am inclined to think that unless the Association feels that it should follow the lead of the N.E.L.A., and as a body oppose municipal ownership, it would be desirable to extend full membership privileges to not only municipal men, but also to others who are at present debarred from that privilege. Such action, it seems to me, would much benefit the Association, because it is plain that at the present time it is the loser by the absence from its Conventions and its Committees of many able men who used to be among its enthusiastic supporters, but who have since joined the municipal ranks. It would be helpful in deciding such questions to know the opinion of our Managing Committee, which must have given the matter serious consideration.

Mr. Phillips, Brockville: Mr. Chairman, I am here as a guest to-day, although I have been a member of the Canadian Electrical Association for many years, and I want to make the thing plain from my standpoint and also from the standpoint of members and other gentlemen who are here to-day.

At the Niagara Falls meeting a by-law was passed preventing the managers or superintendents of municipally owned plants from becoming members of the Executive, or being actual active members of the Association. Now, I myself have opposed municipal ownership as strongly as any man belonging to the Canadian Electrical Association, and after having done that, and after having been a member and being eligible as a member of the Canadian Electrical Association for years, because I take charge and manage a municipally owned plant, why should I be debarred from being

an active member of the Association? The thing on the face of it is wrong, in my opinion, because if a man is eligible under one condition, why is not he under another? Now, to-day this municipal ownership disease, or whatever you like to call it, is spreading over the country. If the private corporation has anything to show the municipality why municipal ownership is wrong, the proper way to do is to bring them into the Association and show them there. You will never accomplish anything by bucking the thing and keeping the members out. That is a sure thing. The Association to-day as it stands, as has been mentioned, is not on a strong financial basis. The reason is, the number of plants who would be willing to help support the Association, simply stay away or they can come down here as guests, and they do not contribute anything to the Association, and the consequence is they get the same benefits as though they were active members from any papers read. And I would be quite willing, as far as I am concerned, and many others the same way, to come to the Convention and take an active interest in it, but a man won't do that unless he has some definite interest in the thing. I know all through the country here where Hydro Electric has come into force—they are classed as municipal plants—the same bunch of fellows come to the Convention as members, but they are sore about that by-law. When it was passed I must admit, although I read the thing, that I did not read it as it was in the English that it was put. That is a sure thing.

The President: I would be glad to hear from any others or any members connected with any bodies outside the strictly private operating companies.

Mr. Moore, Simplex Heating Company: As a representative of the manufacturers I rather hesitate to butt in on what I consider the property of the operating men, but I think I voice the sentiments of perhaps three-quarters of the attendance at the Convention to-day when I say that the actual control of the Association does not matter very much; that a great many of us are interested in coming here primarily to get acquainted with one another and swap experiences along the lines of electrical business, and we get just as valuable information from the lineman and from the contractor, from the manager of the municipal plant or from the manager of the private plant. If we could have an association that would embrace everybody in the business it would be a good thing. Let us sectionalize if we want it—let us have company sections or contractors' section or manufacturers' section to take up their own particular problems, but let us have some organization that will embrace everybody.

Mr. Lambe: May I disagree with my very good friend, Mr. Moore. It seems to me that if you have control centralized in one set of men, you get a result that must simply be the idea of that particular section. For instance, the N.E.L.A. amalgamation would never have gone through if it had not been for the fact that the control is in the hands of the Central Station people. From their standpoint it was a very good move, and I agree with it, looking at it from their point of view, but I think you must admit that it was the result of sectionalized control.

Mr. Moore: I did not mean to defend any sectionalized control. I

think that is a problem that may be worked out among the different interests so that the control should not be in the hands of any one group.

Mr. Lambe, Ottawa: I understand you to say that it did not matter as to where the control was; personally I would say have diversified control—have representations from all the different membership sections.

Mr. Moore: I would accept that.

The President: Any further points of view?

Mr. Hartman, Coppercliff: I am one who was out of sympathy with the move of affiliation, and in connection with that, I notice in Mr. Young's report, one expressed the opinion that the old Association was a failure. Now, in re-organizing, if we should do so, we propose to make an association somewhat like the old one. The more active members in the re-organization felt no doubt that the old Association was a failure, and the statement mentioned was no doubt thoughtfully made. Now, if it had certain elements of failure in it, if we could find out those and then re-organize, taking advantage of this experience. (Applause.)

Mr. Gould, Smith's Falls: Mr. President, it seems to me that the chief objection to the thing is, that according to our affiliation with the N.E.L. Association, many people engaged in the business in Canada are excluded from membership in our Association as it is constituted at the present time. If an arrangement could be made with the N.E.L.A. whereby municipal and all other men were admitted to membership the difficulty would be immediately overcome. We had this up at the meeting in Toronto about two months ago, when invitations were sent out to Central Station managers and others to attend a special meeting, which I attended. I was in favor of the affiliation with the N.E.L.A. principally for the reason that Mr. Dion advocated it, as I did not know very much about it. I found out more about it at this meeting held in Toronto a month ago than I knew before; that the whole objection seems to be that on account of this inexorable rule or law of the N.E.L.A. municipally owned plants and their representatives are not entitled to membership. Well, as has been pointed out by Mr. Phillips of Brockville, the wave of municipally owned plants is extending so throughout the country, and especially throughout Ontario, that if some move be not made in the direction of having a wider membership there won't be in a short time enough of us left to carry on an organization. That is the biggest difficulty that I see in connection with it. It was suggested at this time I speak of, a few weeks ago, that perhaps the institution could be re-organized, put back on the lines of the Canadian Electrical Association as it was before this affiliation, and men who found it to be of interest to themselves to retain their membership in the N.E.L.A. could do so. Personally I would not like to give up my connection with the N.E.L.A. I find it to be of great benefit to me on account of the information we obtain, which we would not otherwise have access to. That is the chief benefit of this membership to me. As far as I am personally concerned I would like to see a Canadian Electrical Association that would be broad enough and wide enough to admit every person across its threshold who would be interested in the electrical business and who desired to become a member.

I would like to hear very much from Mr. Dion as to how these objections can be met and how they can be overcome. It seems to me to be quite plain,

and I would like to emphasize that again, that on account of the wave of municipal ownership which is passing over Ontario, that if we do not broaden our membership, if we confine it in the narrow limits in which it is at the present time confined, the actual membership in our organization must of necessity before very long become very limited. (Applause.)

The President: As our time is rather short, I will ask Mr. Dion to reply to Mr. Gould.

Mr. A. A. Dion: Mr. Chairman, I have little exception to take to any of the statements that have been made by previous speakers, because each one from his point of view is perfectly right. It is just a question of point of view. What are the objects of the Association? What do we want? If those objects are to be social and educational, if we are to meet here only to get better acquainted and to learn from each other how to run our business, then a general association might perhaps meet those needs better than a restricted one. But if our object is to go further than that, if our object is, as I believe it should be, to further the business interests of the Companies in this Association, then I say it should be confined to and controlled by privately owned operating companies. I have been of the belief that we could maintain an association in Canada along these lines, exactly along the same lines as the National Electric Light Association, and that is why I was one of those who advocated the affiliation. I predicted that this affiliation would be of benefit to a number of companies, and it has been. Take the question of information alone. We had 20 companies members of the N.E.L.A. in Canada; to-day we have over 50; therefore there are 30 companies more, and over 300 individual members besides, getting bulletins and proceedings of the N.E.L.A. I think no one will contradict me when I say there is no more valuable literature of its kind extant in the world. (Hear, hear and applause.) You simply cannot get that information anywhere else. And as far as my Company is concerned we would be members in that Association anyway, no matter what took place here. We cannot afford to leave it, and I think that applies to every privately owned company in Canada, although some of them, perhaps, do not understand it at the present time. That is the whole thing in a nutshell. If we are to abandon trying to do anything that we can do to further our business interests, then my objections to a general association fall to the ground. Personally I am not prepared to abandon hope until later that we can further those interests by an association like this. Possibly the time may come when we shall have to do so. Possibly the municipal wave which is sweeping over the country will engulf us all and then it will be a case of natural death, but I hope that time is not too near. Sometimes I think that we have passed the crest of the wave and there is going to be a reaction. Perhaps I am a visionary. I rather believe in this reaction. The question in my mind is whether I shall live long enough to see it bear fruit.

Several of the speakers have referred to the old Association. Why don't we get back to the old lines? Now, what were the old lines? What has been the Canadian Electrical Association? It has been run on exactly the same lines as it is run this year, with the exception that we admitted representatives of municipally owned plants to our meetings without any other privileges; that is, to attendance at our meetings and privilege of

getting the printed proceedings. They had no votes and they were not eligible to office, and there were no complaints from any municipal men on that score. That is the only difference.

Now, you ask for a solution, for something that will reconcile all opinions. In my mind that is quite impossible. One suggestion might be that we separate from the N.E.L.A. and go back to the old lines. This would give admission to the Conventions of representatives of municipally owned plants, but it would not give them any privileges of holding office. I think it is important that the control should be in the hands of Central Station owners if it is going to be of any benefit as a business association. Sometimes I have heard people make wild remarks, such as the "influence of the N.E.L.A.," etc. Now, if the N.E.L.A. has had any influence on us it has been a good influence. It has been an educational influence, but it has not gone beyond that. We are to-day just as much a Canadian Association as we ever were. We are adsolutely independent in our proceedings and our legislation. The only thing we did when we went into this affiliation was to adopt the classification of the N.E.L.A. as to membership; that is all. Otherwise we are absolutely independent and we have our own constitution, and I would ask any of those who have attended our Conventions for the last three years under the present arrangement, whether he has seen any difference or if the Conventions have not been as largely attended or as successful as they were in the past. The N.E.L.A. is essentially an Association of privately owned plants, and I do not believe it is possible for them, without tearing the whole thing to pieces, to consent to any modification. I have no quarrel with the municipal men; it is just a question of business interest, whether there is any need for companies to associate together for business purposes. I believe this is true. So much so that I made this suggestion at the meeting in April when the matter was under discussion, that if it was thought necessary to make a broad, general Association, we would continue the present Association, under another name if necessary, as a purely business Association. I would be prepared to give up the name and let it be applied to a general Association, but I would be in favor of retaining by privately owned companies their affiliation and association for purely business purposes. And possibly that may be one solution.

I do not know that there is very much more to say about it. We hold different points of view and it is hard to reconcile them. I may say this—when the C.E.A. was first organized it opened its doors to all sorts of people. We had men engaged in the telephone industry, we had telegraph men, we had street railway men, electric light and power men. What was the result? The telephone men dropped out. They had no community of interests with any of the others. The telegraph men dropped out. All efforts to bring them back failed. The street railway men dropped out and formed an Association of their own, feeling that their interests required particular treatment, and that left the power and light alone. And then the Association became really a light and power organization, with the addition of municipal men as associate members. The next step was the exclusion of municipal men. This was done with regret as far as I am concerned. We felt our interests were such that we could not discuss our business matters with them, when in some cases they were our competitors. This is a business question you will all understand. Anyway, I think the time is hardly ripe

for a change; we have not made up our minds what we want. Another thing, there is a difference between what we want and what we can accomplish. We may want a general Association, but can we keep it together? I would suggest that things be left as they are for another year and to take it up later. I for one feel we are not prepared to deal with it, and in a case of that kind when there is some doubt as to what we should do, it is better to let it alone. Those are my views. I have held them right along. I am willing to hear any argument to the contrary. I feel that many of the men who have spoken or who have written letters to the *Electrical News* may not really know what they want and have not seriously considered whether it is practical or not. (Applause.)

Mr. T. S. Young: I only intend to take up one minute. Mr. Dion, as expected, covered the point which I desired to refer to as mentioned by Mr. Phillips, and that was to emphasize the fact that it is many years since municipal men were active and voting members of the Association. They could be members but had no vote.

I believe that every Central Station man who is a member of the N.E.L.A. values very highly his connection with that Society, and if I were interested in a Central Station Company I think I would want to continue my membership. But can we continue an association conducted along the lines of the present Association?

Some years ago the Canadian Electrical Association was in a different position, and there were very few municipal plants. We could then call ourselves the Canadian Electrical Association. Since that time municipal ownership has grown so rapidly that there are very few private plants in Western Canada, with the result that the Canadian Electrical Association would find it practically impossible to hold a Convention in Western Canada. It becomes an Eastern organization. And if it is continued along the present lines it might be worth consideration whether it should not be called the Canadian Electrical Power Association, that the field which it covers might be more clearly defined. Whether or not there is a need for a broad association to include all men engaged in the electrical business I think is somewhat answered by this Convention. Conventions are not everything—I quite realize that—but this Convention emphasizes the fact that there is a great deal of valuable information to be obtained, and that much of this information can be obtained equally as well from the electrical engineers, the superintendents and managers of municipal plants as from the officials of private plants.

If action is deferred to another year I presume no great harm will be done, but, as has been intimated by Mr. Lambe, it seems necessary to look the situation right in the face and decide what is the best in the interests of the Association.

The President: I am sorry the time does not permit any further discussion of the matter. Everybody should bear in mind that in the life of every organization, if you have in the control of the organization two diverse interests—can that organization live and continue not only now but through a perid of years? That is one phase of the question which the Executive have got to consider. It does not mean antagonism; it simply means,

will that organization continue to exist? It is purely a question of the life of the organization, and how best to continue it. If you have diverse interests in it, one which might be opposed to the other, then inevitably there must come friction and division, and then you will be further behind than you otherwise would be. We have shown here at our Convention that we can come together, we can unite, we can discuss matters, and we practically get all the benefits of any Convention. If the Central Station companies take on the burden of carrying on the Executive part of the affairs, I am sure there are many of us who would be glad to be relieved of it, however much we appreciate the honor. It is no light task to have to carry on one's own work and in addition carry on that of an outside organization, separated as we are too often by distance, and at great inconvenience of time and breaking in on our regular duties, and I can assure you that the members of our Management and Executive Committees and those preparing the different papers and making this Convention the success which it is, have had an arduous work. The Executive will consider this broadly and from no narrow point of view, but the ultimate decision must rest with the Executive on this question, and it will be up for further consideration. As far as our present Executive is concerned, that is changed from year to year with the change of administration. One of the points on which private companies always feel they are at a disadvantage as compared with municipal organizations of the electrical industry, is that they must live or die whether they make their success or not. They cannot change the responsibility or burden the responsibility on to other shoulders or some other utility, or the taxpayers as a whole by any indirect process and therefore it is a serious proposition to the operating companies. Rates often alone are compared. Service is very often placed as of secondary consideration, whereas it should be of the first consideration. (Applause.) There is a continual evolution—I might say revolution—in the growth of the industry. Lamps, plant and equipment are being discarded and thrown on the scrap heap. Bonds or debentures have been placed at long periods to cover such equipment, for which there is nothing to show long before the end of that period, the equipment long since having gone on the scrap heap, due to this revolution taking place in the industry. We can see no end to it. We can only know in the future there is an immense development ahead of us. Another phase of the question which private operating companies are up against as compared with the other side is that of taxation. In one case taxes must be taken into consideration in fixing the rates; taxes in the other case are not entered into consideration in arriving at costs. The taxpayer has to pay that tax which would otherwise be paid into the municipality by private company. In case of private company the burden or responsibility always rests with the company; in the case of a municipality, change of administration is taking place—well, if the thing is not a success, the man who originated that idea is long since lost to public life. You cannot place the responsibility. The future must take these things into consideration.

It is a broad question; something which gives us all subject for consideration. I would just like to repeat that there is no question of antagonism, no question of personality, purely a question of what is the best thing to be done under the circumstances.

I will now adjourn this Session.

AFTERNOON SESSION.

At 2 o'clock p.m. a meeting of the Executive (Class A and Class B members) was held, the President in the chair.

Moved by Mr. A. A. Dion, seconded by Mr. D. H. McDougall, that minutes of last meeting be accepted as read. Carried.

On motion of Mr. R. J. Smith, seconded by Mr. T. S. Young, the Secretary was empowered to cast a ballot, which resulted in the following officers being elected:—

President - - - - - - - - -	D. R. Street, Ottawa.
1st Vice-President - - - - -	A. L. Mudge, Toronto.
2nd Vice-President - - - - -	D. H. McDougall, Toronto.
3rd Vice-President - - - - -	Wills Maclachlan, Toronto.
Honorary Secretary - - - - -	T. S. Young, Toronto.
Secretary-Treasurer - - - - -	H. G. Martin, Toronto.

MANAGING COMMITTEE.

A. A. Dion, Ottawa.	W. L. Bird, Fort William.
J. S. Gould, Smith's Falls.	W. S. Robertson, Toronto.
F. G. Clark, Toronto.	A. E. Dunlop, Pembroke.
L. Pratt, Hamilton.	R. M. Wilson, Montreal.
R. S. McDunnough, Three Rivers.	R. H. Sperling, Vancouver.
H. G. Matthews, Quebec.	R. J. Smith, Perth.
E. L. Milliken, Sydney.	W. J. Angus, Hamilton.

Moved by Mr. A. A. Dion, seconded by Mr. D. H. McDougall, that the following resolution be adopted:—

"That Class A and B members of the C.E.A. in executive session, after having heard the discussion on reorganization at this morning's session of the Convention, and having heard Mr. T. S. Young's report on the postal rate taken by the *Electrical News*, resolve that they do not feel justified in changing the constitution of the C.E.A. at this time." Motion carried.

Acting on a suggestion contained in a letter received from the Hydro Electric Power Commission of Ontario, the Chairman appointed the following committee to go into the question of formulating suggestions and amendments to the rules and regulations of the Commission:—

F. G. Clark, Toronto. A. L. Mudge, Toronto.
W. J. Angus, Hamilton.

Mr. A. A. Dion then spoke in appreciation of the visit of Mr .T. C. Martin and Mr. E. W. Lloyd, and after a short reply by each of these gentlemen the meeting adjourned.

THIRD DAY—MORNING SESSION.

Friday, June 27, 1913.

On resuming at 10 a.m.

The President: There are two papers here on Electric vehicles, one by Mr. Thompson and one by Mr. C. Rummel. We will ask the writers to read their papers and then have a joint discussion on the two papers.

Mr. Kerr, would you mind reading Mr. Thompson's paper.

The paper, "The Electric Vehicle," was then read by Mr. Kerr.

THE ELECTRIC VEHICLE

By Stephen G. Thompson
Electric Vehicle Association of America

It is probably noticeable that in most discussions and printed articles touching upon the subject of the electric vehicle, prominence is given to the power wagon rather than to the so-called "pleasure" type. The reasons for this are many, principal among them being the utility feature of the commercial vehicle in our daily lives.

Although there is ample field for the use of the electric pleasure machine, the probabilities of its general adoption appear remote at the present time, simply because of the high relative first cost as compared with the gasolene machine for similar service.

On the other hand, visible evidence of the possibilities of electric commercial vehicle application is apparent on the slightest investigation. The congested traffic conditions of our city streets is an emphatic argument in favor of the adoption of the power wagon, and, needless to say, the **electric** power wagon. Why the electric? you ask. By what right do I thus summarily dispose of the gasolene machine? For the simple reason that the electric power wagon has for the past ten years continuously demonstrated its superiority over any other method of city and suburban merchandise distribution, and the bulk of highway freight movement is confined to such areas. The evidence is not far to seek. On every hand are found electric vehicle installations whose investment values are of such magnitude that common sense dictates that the selection of type must have been only after exhaustive investigation. Electric vehicles are not peddled. They are not foisted upon a gullible agent with a demand that he contract for and dispose of a certain quantity within a given time, with the purpose of "loading up" the factory, and incidentally risking the effect of misapplied machines through the anxiety of the agent to fulfill his obligations.

It is true that repeat orders for gasolene machines are not uncommon, and the manufacturers make capital of such in their advertising. This proves nothing. Either the application was originally correct, or no investigation was made of any other form of power wagon. "Preference"—that is the word which describes the mental attitude of many vehicle purchasers. Let me quote from the remarks of an official of one of our leading express companies; and, by the way, these same express companies—whose business is almost entirely confined to city areas—are adopting the electric over all other types of machines, and this after nearly ten years of experimenting. To return to the remark of the express company official. He says: "At first sight the gasolene vehicle appears the most attractive." Oh, what a depth of meaning in those first three words: "at first sight." Knowing, as I do, the trials and tribulations through which this company has waded in its experiments, and catering to "preference" and prejudice rather than to

practicability and demonstrated results, what a world of meaning those three words convey: "at first sight." And the difficulty is that in the purchase of power wagons these identical methods are still being pursued, based on "preference" and on "first sight." Why the preference? you ask. The answer is to be found in the popular knowledge of gasolene pleasure cars, their operation and construction, and the extensive advertising of the commercial gasolene vehicle makers.

Here, too, "first sight" appears upon the scene. Before me is the advertisement of a prominent gasolene manufacturer, who says: "The Adams Express Company have 160 of our machines; and, further, the Adams Express Company have discarded horses altogether in the Philadelphia district." Both statements undoubtedly are true, as the Adams Express Garage in Philadelphia now houses over 100 of their electric vehicles, and, further, the Adams Express Company depends upon electrics (almost entirely) in eleven cities in the United States. In fact, this company is the largest individual operator of electric trucks in the country.

It is interesting to observe that with those concerns of whose business a considerable part is teaming or delivering, electric trucks find special favor. It is but a few months since one electric vehicle salesman retailed a million dollars' worth of electric trucks to the brewery trade. While this was merely a repetition of a similar performance of a year ago, it emphasizes the fact that the economies presented by electric truck operation are sufficient to warrant very extensive investment in this type of machine.

Now do not misunderstand the purpose of the foregoing remarks. There is no desire to discredit the gasolene machine, for, in its field of application, it brooks no competition. But its field of application is not generally found within city limits. Its principal advantage lies in its ability to travel at a high rate of speed, and in cities this is not permissible. Frequent stops and starts reduce its average speed to below that of the electric, and the total running time possible in a full day's operation is not sufficient to allow of a mileage radius beyond that of the electric.

Paradoxical though it may seem, an electric machine of moderate speed capacity will move faster in city streets and where the stops are numerous, than will a higher speed gasolene truck. Prove it? All right! Here is the result obtained on test under identical conditions. The electric vehicle was geared to a maximum speed of 12 miles per hour; the gasolene to 18.

TEST No. 1.

Total number of Stops..24
Distance between Stops.................................... .42 of a mile
Duration of Stop.. 2 minutes
Course, triangular; road conditions, good.

Average Speed M.H.P.

	Elec.	Gas.
Leg. 1—Level........................	10.76	9.41
Leg. 2—Up...........................	7.08	8.85
Leg. 3—Down........................	11.12	7.20

TEST No. 2.

Total number of Stops..24
Distance between Stops.. .42 of a mile
Duration of Stop... 1 minute
Course, triangular; road conditions, good.

Average Speed M.P.H.

	Elec.	Gas.
Leg. 1—Level........................	11.4	10.08
Leg. 2—Up...........................	6.9	7.83
Leg. 3—Down.........................	11.8	10.56

Average Speed M.P.H.

	Elec.	Gas.
Test No. 1............................	9.65	8.48
Test No. 2............................	10.03	9.48
General Average Speed...............	9.84	8.98

It must be noted that the electric vehicle shows a general average speed of nearly 10 per cent. greater than that of the gasolene machine, although the latter was geared to a speed 50 per cent. higher. The engine of the gasolene car was kept constantly running throughout the duration of the test. The effect of rapid acceleration and deceleration possible in the electric machine is indicated by the increased average speed even when running down grade.

Nor is the electric machine supreme only in performance. In the item "cost of operation"—ever a vital one in vehicle service—this type of machine shows to the best advantage. In an extended investigation of the operating costs of gasolene and electric machines in several similar lines of business, the data collected disclosed the startling fact that for the electric vehicle the average cost per car mile for maintenance increased only 13 1/3 per cent. over a period of four years, while that of the gasolene increased 362½ per cent. in the same time; and, further, at the end of the four-year period the maintenance cost for the electric vehicle was less than 50 per cent. of that of the gasolene. The exact figures are as follows:

	No. of Machines Reported.	Average Maintenance Cost after 7 Months' Operation.	Average Maintenance Cost after 48 Months' Operation.
Gasolene..........	54	4. c.	18. c.
Electric...........	69	7.5	8.5

The above figures were obtained from the records of the operators themselves, and include all items chargeable to the replacement of mechanical parts, storage batteries and tires.

The reason for the disparity between the cost of electric and of gasolene vehicles is found in the simplicity of construction and design of the former. The motor mechanism has but one rotating moving part as compared with several hundred moving parts in a gasolene machine. The electric machine is free from the intricate mechanical contrivances to convert the high operating speed of the motor to a slow wheel speed for propelling the vehicle. The source of power, the storage battery, is rugged, costs little to maintain, and its reliability is vouched for by the gasolene vehicle makers themselves, who are equipping modern machines with electrical starting devices, laying great stress on the emergency feature presented by the use of such apparatus, while the balance of the electrical equipment is much simpler than is that of the sparking mechanism of the ordinary gasolene engine.

Because of the characteristics of the motor, which tends to slow down under excessive current flow, the electric machine is not subject to the effect of the abuses of an unskilled operator, while simplicity of construction permits of ready repairs, so that the machine is seldom out of service for any extended period.

Considering the increased high average speed of operation in city delivery service, and the increased operating cost, it is no wonder that nearly all large vehicle installations are of the electric type, and that less than ten active electric vehicle manufacturers are marketing over 20 per cent. of the total number of commercial power wagons employed—this in competition with over 300 makers of gasolene trucks.

Mr. Hillman reads paper "Electric Vehicles from the Central Station Point of View."

ELECTRIC VEHICLES FROM THE CENTRAL STATION POINT OF VIEW

By C. Rummel
British Columbia Electric Railway Company

It is the general policy of our Company to leave the selling of appliances and current-consuming devices as much as possible to local dealers and agencies. This policy is based on the idea that our business is primarily that of a central station and that we should enter into the actual sale of current-consuming devices only when the local dealers and agents fail to push the sale of any particular branch as vigorously as the conditions warrant.

In the field of electrical vehicles the Company found that there were a number of agencies within our territory, the same firms offering both gasoline and electric vehicles. These firms sold quite a few pleasure cars of the electric type but apparently made very little effort to introduce electric vehicles of the commercial type. It was found that when these dealers, being representatives of both electric and gasoline cars, came to a probable customer, the "prospect" generally knew considerable about gasoline cars but very little about electrics. The agent would tell him that he represented both electric and gasoline cars and would put forward the advantages of the type which the "prospect" preferred. This method of doing business was rather a detriment to the introduction of electric vehicles within our territory. To me it seems rather a mistake on the part of the manufacturers of electric vehicles to act through these combination agencies. The agent is, of course, after the dollars and cents and will naturally interest himself chiefly in the article which he can sell in the easiest way and to the greatest number. I have been told by a factory representative that the manufacturers do not care very much in the case of truck sales, their object being to have agencies sell pleasure cars, and that the field for electric vehicles of this type is so limited that it is impossible for one firm to handle the exclusive agency. The manufacturer noted has doubtless come to this conclusion after a thorough trial and we must take his statement as warranted.

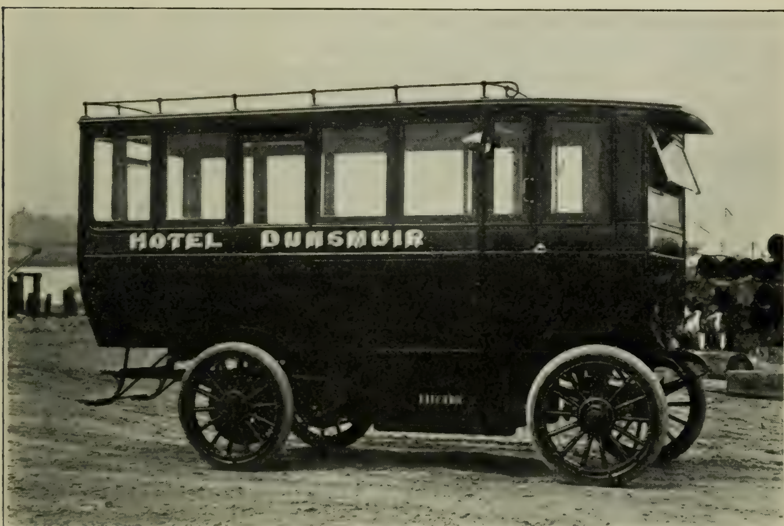
As far as Vancouver is concerned, our Company found that the practice of selling through combination agents did not result satisfactorily to our interests in connection with the sale of electric cars of the commercial type.

As a result of the above condition the Company this year decided to take out an agency, enter the selling field and make a genuine effort to introduce electric commercial cars within its territory.

The first attempt to sell electric cars in Vancouver was made some seven years ago when a five-ton Studebaker truck was purchased by a local

firm. There was at that time no proper electric garage or adequate arrangement for charging batteries of electric trucks, nor was the proper usage of the truck understood. Hence the car suffered considerably because of lack of facilities and ignorance as to the proper method of caring for it, this being especially noticeable on the point of overloading. However, in spite of these handicaps, this five-ton truck is still in use to-day and doing good work.

In connection with its own work, our Company purchased three electric trucks last fall, these being the only sales of electric trucks made at that time by local agents. These vehicles were used as a meter wagon, an arc lamp wagon and a line wagon, and did satisfactory work through a severe winter during which there was a heavy snow fall such as had not previously prevailed in this country for 15 years.



On the basis of the good showing made by the few electric trucks in Vancouver, the Company felt that vigorous efforts should be made to introduce this type of vehicle, although still preferring to leave the matter in the hands of the agents providing the business was properly pushed and adequate garages and facilities for caring for the vehicles would be provided. Upon canvassing the agents it was found that they preferred to have nothing to do with the garaging of trucks but preferred to confine their business in the electric line to pleasure vehicles only. The Company then decided to take up the agency for commercial cars as previously noted.

At the very outset the Company engaged an electric vehicle expert of 11 years' practical experience, both in selling and garaging. This man was given the advantage of extensive advertising in the daily press, thus thoroughly acquainting merchants with the advantages of electric trucks

as well as the entrance of the Company into the business. The salesman began his campaign among the wholesale men on February 15th, and has since been conducting an active canvass by personal visitation, follow-up letters, pages in the monthly motor magazine, etc. One very effective method followed was to offer the service of one of the Company's trucks to reliable "prospects" for an ordinary day's delivery of the firm. Such an illustration proved conclusively the value of the truck to the merchant's business.

Since our salesman took hold of the work, sales of electric trucks have been made as follows: A two-ton truck to a wholesale fruit merchant, a two-ton truck to a wholesale hardware firm, and a one-ton truck for an hotel bus.

During the period the Company has also found use for two two-ton trucks which have replaced a gasoline truck and a horse-drawn wagon and a business electric for the light and power department. The two-ton truck for the fruit merchant was placed on the streets last week and has so far given perfect satisfaction. The Company's new trucks are also working satisfactorily and the hotel bus will be placed in operation about June 1st.

In addition to the Company's orders, there have been sold to Vancouver firms through outside agents a two-ton truck of the electric type to a milling firm and a 750 lb. delivery rig to a local fish concern.

Our electric vehicle representative reports that his "prospects" are many, and every merchant to whom he has explained the electric trucks, even milkmen who have a house to house delivery, are interested.

In carrying out its business as an agent for electric vehicles the Company generally orders the chassis only from the factory, the bodies and tops being built in the city to suit the purchaser. This plan is necessary from the standpoint of economy owing to the duty which must be paid on our cars from the States. It is also found that each customer has his own ideas as to style, dimensions, etc. of the top and body, and, if this work is done locally, closer supervision can be given to each part by the purchaser and he is better satisfied with the result.

Early in the campaign for the introduction of electric trucks the Company found that there was a necessity for a proper garage for this type of vehicle. To meet this condition and cover the care of the Company's trucks as well as those of our customers who did not desire to install their own charging outfits, it was decided to arrange for a garage in the central part of the city. This is now being built, and will provide 110 x 94 feet of floor space and a charging outfit consisting of a motor generating set of 45 K.W. capacity. In the garage will be located offices for the superintendent and mechanic, battery room, store room for spare parts, tires, etc.

Before plans were finally made for the Company's garage a meeting of all the dealers in the city interested in the sale of electric trucks was held. At this conference the electric vehicle question was discussed in all its phases, various types of batteries, their behaviour, their troubles and other points of interest being thoroughly considered, the meeting thus being most helpful to all in attendance.

At this meeting the charges which the Company proposed to make for caring for electric vehicles of the commercial type at its garage was outlined and an agreement reached with the dealers on this point. These charges, which cover all types of battery, were as follows:—

Capacity of Truck.	Garage Charges Per Month.
750 lbs.	$45.00
1000 "	45.00
2000 "	50.00
4000 "	55.00
7000 "	60.00
10000 "	65.00

These garage charges cover the supply of current necessary for the operation of the vehicle, charging of the batteries, storage of the vehicle, daily washing and oiling, and the making of minor adjustments. These garage rates being established, our electric vehicle representative was able to quote to his "prospects" with assurance just what the cost of their deliveries by electric truck would be, a most telling argument with the prospective purchaser.

It is not the intention of the Company to care for pleasure vehicles in its garage, as this field of work is already receiving the attention of the regular garages. For the storage of a car of this type, current for and charging of batteries, daily washing and oiling, etc., a monthly charge of $30 is made and in some cases the garages deliver and call for the vehicles.

A report has been recently obtained from the provincial authorities covering the number of electric vehicles which are now in use in British

Columbia. According to this statement there are 100 pleasure cars and 18 electric trucks now operating within the province.

The field covered by our Company comprises as a territory in which electric trucks would be chiefly used, the cities of Vancouver and Victoria. The references made in the preceding paragraphs to our agency for commercial cars, the establishment of garage, etc., refer only to Vancouver, where the head office of the Company is located. The notation with reference to electric vehicles, however, applies to the entire province and a number of these vehicles are operated in and about Victoria. Last year a large milling firm bought a two-ton truck for its Victoria trade and after operating the vehicle for a year was so satisfied with the results that this spring the concern purchased a five-ton truck and a two-ton truck, the latter now being in operation in connection with the firm's business in Vancouver.

In both Vancouver and Victoria a number of the private garages are equipped with charging outfits for electric vehicles and the Company also plans to maintain charging equipment at central points within its territory.

The various reasons why central stations are or ought to be interested in electric vehicles have been talked and written about to such an extent that it would be wasting your time to repeat the many thrashed out and worn phrases. Every central station man knows that if he can conduct an electric garage where he can induce his merchants to come to with their wagons and cart away the juice, that this not only saves the cost of distribution lines but that he has here a load absolutely under his own control in the matter of delivery. The majority of the wagons are charged after 9 or 10 o'clock in the evening, and once in a while a wagon might need boosting during the noon hour. Every central station man I have met admits that where a good vehicle charging business is obtainable there is not a more ideal load from a central station point of view.

Since entering this field I have noticed that the vehicle manufacturers look for the assistance and co-operation of the central station, and I found on my recent trip down the coast that every central station manager is fully alive to the possibilities of this new current-using device. The rates made for current leave no room for competition for either the horse or gasoline wagon in respect of cost of operation. If the manufacturer will now fulfil his part and bring the cost of the truck within reach of the average merchant and not only of a prosperous few, the co-operation so attained would be most effective and complete. Our Canadian prices are at present too high. The cost of a five-ton truck f.o.b. Vancouver is about $7500.00, a first investment which is beyond the means of the average merchant. The "Ford" people here are selling a 750 lb. gasoline delivery rig for about $800.00. The electric 750 lb. delivery wagon laid down in this city costs in the neighborhood of $2500.00. It must be admitted that in face of this tremendous difference in first cost it requires an excellent salesman to convince a "prospective customer," that in spite of this difference he is making a saving by buying an "Electric." Most of this saving the central station claims is due to the economic operation of the Electric, brought about by low rates of current offered by the central station. The next move should

therefore be on the part of the manufacturers to produce a vehicle at reasonable cost to the Canadian merchant.

I trust these few remarks will bring out a lively discussion at your meeting, and that the above information will be of value to you in obtaining an idea as to the situation of British Columbia with reference to elecric vehicles.

DISCUSSION.

THE PRESIDENT: In opening up the discussion on these two papers, one of the salient points which struck the speaker was the comparison of first year's operation with that of second year's operation, comparing electric vehicles with gasoline. This paper is now open for discussion. We have a splendid opportunity to get first-hand information to-day as to the method of introducing such new equipment or any other information the members may desire.

MR. E. G. MCBURNEY: In Mr. Rummel's paper (page 166) he speaks of the exceedingly high cost of electric trucks, and gives a price for a five-ton truck of $7,500 at Vancouver, B.C. This seems to be too high, as a five-ton truck here would cost about two-thirds of that, and this price will be further reduced when the assembling and production commence in Canada. The ordinary so-called small truck is usually an automobile chassis with a truck body, and cannot be compared in price with a standard electric vehicle rated for the same load, as one is a straight-truck proposition and the other an automobile.

There is another question which I would like to bring to your attention in connection with Mr. Rummel's paper; that is, on page 162 he states:—

> "As a result of the above condition the company this year decided to take out an agency, enter the selling field, and make a genuine effort to introduce electric commercial cars within its territory."

The main advantage in connection with the above is the fact that in taking out an agency the company will not only be able to successfully push the sale of trucks, but will be able to standardize them, and not have to carry spare parts for ten or twenty different types, and the Central Station man can also, by this means, put in a battery service department on a rental basis.

MR. MUNRO, Peterboro Light & Power Co., Ltd.: I would like to ask the gentleman who read this paper if the life of electric vehicles is longer than that of a gasoline vehicle, supposing it receives the same attention during its use, and therefore, whether or not the first cost would be spread over a longer period and the sinking fund charge thus cut down?

THE PRESIDENT: Have you, Mr. Dion, had some experience with electric vehicles?

MR. A. A. DION: I think the point that has just been raised is a very important one. If the first cost can be spread over a greater number of years, then it does not seem so alarming. There is no doubt that the first cost of an electric vehicle is high, especially in this country, where we have to pay the duty. The manufacturer will tell you that he cannot

reduce the cost because of the small output. He will tell you that if you help him to sell electric vehicles, you will hasten the day when the price can come down, and this also applies to duty, because, if we can increase the market in Canada to such an extent that the manufacturers will be warranted in manufacturing on this side, then the prices will come down, It is one of those things that can only be brought about by co-operation between the operating companies—those who sell the cars and those who make them. There is no doubt that gasoline cars have been offered to do the same work as the electric truck at about one-third of the price, but you all know that this is due to the enormous output of this particular truck, and even at same cost of manufacturing, you could not expect an electric truck to be sold at anything like the same price until the consumption or the use of those trucks becomes as large. We are all hoping for the day when electric trucks will be bought at a reasonable price and when they will be used in large numbers, but it will take a long time. But that should not prevent us from using our best efforts to introduce them. Every car that has been sold is an advertisement and helps to sell several other cars.

I may say, however, up to this time I have not been able to convince myself as an operating man that the operating companies should handle the cars. There are several competitive cars, and if it is left to the agents, spurred by competition, to sell their cars, it occurs to me that we would get better results than if the company adopted a certain make of car, and thereby got the enmity of agents trying to sell other lines. I am pleased to see a paper on this subject written, as this is, by an operating man. So far all the papers we have had in associations such as this, on the advantages of electric vehicles from Central Station point of view, were written by manufacturers of vehicles, and, therefore, they were open to suspicion of bias. This, however, is a pronouncement from a Central Station man, and I believe everything he says as to the advantages. We all know it is an ideal load, and we cannot get too much of that sort of load.

I note in the figures of operation as given there, that the cost of the gasoline truck for the second year had increased very largely—almost doubled. It seems to me that this does not tell the whole story. That increase from 4 cents at seven months to 18 cents at 18 months. This may be a peculiar instance, although it was taken over 54 cars, and therefore it is not an isolated case. This does not tell the whole story, because if the cost of maintenance of a gasoline car has increased from 4 cents to 18 cents in that time, there must be a lot of serious interruptions, loss of time, which should be added to the cost of delivery. There is not any question in my mind about the cheapness of operation of an electric truck as compared with gasoline truck for delivery purposes. I think it can be proved easily. The question is to induce the customer to part with that large amount of money at once. It is pleasing, in this connection, to hear that possibly we will have trucks assembled in Peterboro; that is the way they started making gasoline trucks in Canada, assembling them, and then they made them. And I, therefore, hope it won't be many more years before they are made in Canada.

I might say we have been operating one electric truck in our company. We will probably operate more, because I feel that it is our duty to use

them, even if they did cost a little more to operate than other trucks, simply because the electric truck load is a desirable load, and we cannot expect

there seems to be what is perhaps a misprint; if Mr. Hillman or Mr. McBurney would say something further on the point, it would help us. Then on page 160, in the middle, where the author speaks of the greater deceleration pos-

sible in the electric, I must confess I do not see offhand just why that is so, because it would seem to be very largely a matter of braking; and then, turning to Mr. Rummel's paper, at the bottom of page 166 he speaks of rates for current, etc., perhaps some actual figures would be interesting. Further, I would like to ask, seeing that Toronto is so well served electrically, what they are doing here in electric haulage, perhaps some Toronto people would be kind enough to give us some statistics. The figures given by Mr. Rummel for British Columbia do not at first sight appeal very strongly to one, but you must remember that it is a very mountainous province from end to end, so that outside of Victoria and Vancouver there is no very great field for automobile work, but in the plains cities of Saskatchewan and Alberta they are doing very advanced work in this line. For instance, Saskatoon is equipping its fire-fighting system and its repair wagons for street railway, light and power with electrics, and Calgary, I think, have recently placed an order for six electrics for its various departments, all showing pretty advanced work.

Mr. Merritt, Toronto Electric Light Company, Toronto: In connection with the electric vehicle in the City of Toronto, the company has made no real particular effort to push it beyond giving what is our regular power rate in all cases. Now, that rate is a sliding scale rate; the first 50 hours' use of the demand being charged at 5 cents a kilowatt hour, and second fifty hours' use at 1 cent per kilowatt hour, and all excess current at half cent per kilowatt hour, less 10% cash discount on a one-year contract. Now, that of course applies to one month's bill. In connection with special rates for electric charging over and above the regular power rates, we have not seen fit, at the present time, to make any differentiation, the main reason being that our power rates are so very low at the present time that we are not making much money even at that rate. And in most cases we find that the rate is very satisfactory, because the total cost of current for charging never figures out over $10 or $12 per month per vehicle; that is even with the Edison batteries, which have a relatively high demand. At the present time there are 16 or 18 electric trucks in use in the City of Toronto.

Mr. Lambe: Is that the city itself?

Mr. Merritt: No, I do not mean the city itself, but I meant there are running in the streets of the city by different companies 16 or 18 trucks. The Toronto Electric Light Company are using two small delivery wagons, which up to the present time have given pretty good satisfaction. The only trouble we have had is a little prejudice on the part of some of our operating men because of the relatively low speed of the electric car in comparison with the gasoline. It has not been a case of the current or because of upkeep or anything else; it is simply the fact that some of the operating men in Central Station having charge of the Transportation Department are a little bit slow to convince themselves that the electric car is just as good as the gasoline car, even for the same kind of service. And I think that just what we find in our station is true in nearly all Central Stations that you look into.

The Electric Light Company, at various times here, have conducted rather limited advertising campaigns to push the sale of electrics. We

have had no one particular man to handle the department; the men who are looking after some of the power work also look after the electric vehicle end of it.

With reference to the establishment of an agency by the company, I could never convince myself that that was good policy for any one company, for the reason that there are about six large and reputable truck manufacturers, and if the Central Station uses a certain amount of tact with the agents I think that the competition between the agents for the business will be sufficient to sell electric cars.

There is certainly one objection to that feature mentioned by Mr. McBurney. If you allow any city or any Central Station to permit 6 or 8 or 10 or 12 different types of car to be introduced into the city, and if they are not really well represented—if the manufacturers do not back up what they say—then of course it simply falls back on the Central Station to look after the repairs of the different parts. If the customer becomes dissatisfied on account of the inability to make repairs—especially in this country—to secure any broken or worn out parts, of course he will in nine cases out of ten go back to the gasoline car. I know that in fact is true with the gasoline car itself. Some of the companies are able to maintain an agency because of the large output and large sale of cars in any particular territory. Another fellow comes along and he sells one or two cars, the parts of which are not standard in comparison with some other company which turns out a great many cars. If any parts break and they are unable to replace them immediately, that fellow certainly becomes dissatisfied with the truck. He will probably buy some truck for which he can secure standard parts within a short length of time. I think the policy of the Electric Light Company at the present time is to push the sale of electrics but not endeavor to go into the sale of any one particular type. We find that the agents have recently become very lively here, and nearly all of the trucks which have been sold within the last twelve months have been sold simply due to the efforts of the individual agents. Of course the customer or prospect always comes in nine cases out of ten to the Electric Light Company to get a certain amount of advice. We try to stay on the fence as much as possible, but we do not want to see any one of our customers get the worst of it in the purchase of a car which might not only cause dissatisfaction and loss of sales in future, but cause the Central Station to lose the sale of the current.

One of the most important features in connection with the electric car which I have noticed from Central Station point of view, is the relative revenue per kilowatt of demand in comparison with any other type of load which Central Station can put on their lines. I have figured that out in three or four different cases. Of course it depends on the rate you charge in most cases, but, assuming that the relation is the same in all cities or all Central Stations for the same kind of service—that is, the relation of electric vehicle rates to the other rates; regular power rates are the same—the income per kilowatt of demand would be practically five times for the electric charging what it is for the average other service. Take all of the other power loads, electric appliance loads of all kinds, toasters, irons,

and everything else, and I think you would be surprised at the gross or net revenue income from the electric current used for charging electric cars.

A Delegate: Any pleasure vehicles?

Mr. Merritt: In the City of Toronto I might mention we have at the present time about 125 pleasure electrics. The sale of the electric pleasure vehicles was helped a great deal by the Electric Light Company two or three years ago by assiduous advertising, and by the issuance of small circular booklets, which were sent around to every light consumer in the city. We had about 20,000 consumers at that time, and they were assiduously solicited, not through any personal call of the agent but simply through the mails, and that resulted in a great many enquiries, which were simply turned over to the three or four local pleasure vehicle representatives, and they handled the prospects pretty satisfactorily. In the City of Toronto we have at the present time two large—large for this country—two electric charging stations. One is run by Death & Watson, and the other by Gibson Electric Carriage Company. Each of these concerns has installed 2–55 kilowatt, 75 h.p. motor generator set. Now, the company has helped these companies to get started up by putting out these motor generator sets on a long term basis of payment, distributing the payments over a period of five years. This course immediately helps to take one big load off the garage companies—that is, about $2,000. You will find in a territory like this, some of these people are not particularly anxious to get into this business unless they are certain that they are going to get something out of it. You cannot blame them either, and for that reason people are rather slow in taking up the proposition. Now, these two companies I speak of are agents for two kinds of cars. There are a couple of other companies, which are in the process of formation, which will shortly enter the electric field, I mean the selling and garaging end of it, and we hope to get pretty good results.

Mr. McBurney: Did you ever keep any cost of the electric truck operation and compare with the gasoline vehicle? The figures given for gasoline truck operation are usually based on the price of gasoline in the United States, approximately 16 cents, which is much cheaper than you can buy here, whereas current is usually less here than in the United States.

Mr. Merritt: The figures I have got here for electric current works out between $\frac{1}{5}$ and $\frac{1}{4}$ of the cost per mile of operation. The large five-ton gasoline trucks run about $32 to $38 a month for gasoline. We charge the O'Keefe Brewery trucks, that is four of them, and their total cost for electric current—that is two 3-ton trucks and two 5-ton trucks—figures about $30 per month; that is about $7.50 a month per truck, and the gasoline for those trucks would run about $30 a truck per month. That is a big saving to start with. The cost of current is very low in this city and the cost of gasoline is pretty high, so that for that reason there is a relative advantage to start with in favor of the electric car.

The cost of current for running an electric pleasure vehicle in the city figures out about a cent a mile. That is pretty nearly the same all over the country.

A Delegate: Do any of the car owners have any privately owned stations?

MR. MERRITT: There are a great many private houses or residence garages in the city which have rectifiers, but I am sorry to say up to the present time the rectifiers have given very poor satisfaction. I think the reason is that we have intermittent interruptions at night time on account of our Niagara service and then in the day time the regulation gets bad. Nearly all rectifier companies require that you have about 5 per cent. regulation before they can guarantee the continuous operation of the rectifier. That is not true if you put the motor generator set in. If you put a motor generator set in the batteries will operate the motor generator for ten or fifteen minutes until the current comes back on again, provided you have your switch closed. As soon as the current comes back on your line again it starts to supply energy to the battery. That is one reason why the motor generator set gives much better satisfaction than the rectifier.

MR. MAGALHAES, Toronto Electric Light Company, Ltd.: I do not want Mr. Merritt's modesty to keep back from the Convention one thing which I think has been very helpful in developing the electrical situation here in town. There have been electrics and electric storage batteries in town for some time, but they became out of date or in bad odor for the simple reason that there was no one in town familiar with storage battery operation or electrical vehicle operation. The company realized that fact and have sent Mr. Merritt on two separate trips down through the main electrical centres, both to the manufacturers of vehicles and storage batteries and also to the different Central Stations, getting full information as to what other companies were doing in this line. We then placed Mr. Merritt at the disposal of the public here in town. We feel that our having that source of information for the public has been quite a factor in developing the electrical business here in town, and it is one which I think any Central Station should keep in mind and have some one man who can answer practical questions on storage batteries or on the operation of electrical vehicles.

MR. A. A. DION: If you will allow me to say another word, I would like to state our position as an operating company in connection with the electric vehicle, which is probably the position of every other company, and what is to be done to meet it. We are anxious to develop the electric vehicle business. We realize the advantage of it as an ideal load. Now, we are not in favor of handling the truck ourselves. I think with Mr. Merritt that the best results would be obtained by encouraging others to handle them and trusting to competition. Now, we want to provide all the facilities we can and go as far as we can to encourage the use of trucks. As Mr. Keyes said, we are building a garage where trucks will be looked over and batteries examined; where trucks will not be looked after right along, but where a truck can be brought when it is not working properly, where we will either repair it or advise the owner what to do, and where we will put the battery in good shape for him. Now, we wished to advertise this fact throughout the city. We had an automobile show last winter. We had cards printed and distributed throughout the hall; cards telling the people of Ottawa that they need have no fear in buying an electric truck; that there would be no difficulty in looking after it; that we stood prepared to tell them what to do and to look after their batteries, if necessary, etc. We want to go as far as we can in that direction, but I want

to know what the manufacturer of electric vehicles is going to do. As far as Ottawa is concerned, they have been woefully negligent in pushing their wares. One man came to us and said, "We want co-operation." I said, "Alright, we will help you." He said, "The best way you can help us is by having an electric truck yourself." I said, "What will it cost?" "$3,000." (I could get an equally good gasoline truck for $1,500.) I said, "If I invest $1,500 extra for the purpose of encouraging the use of electric trucks, what are you going to do? Are you going to sell any?" "Yes, we are going to sell them." He said, "If you buy one truck, we will sell others, but that is the first thing that must be done." We bought the truck. I don't know whether this particular man made any strenuous efforts, but he has failed to sell any; over a year now. He sold some pleasure cars. I would like to advise all Central Stations to go as far as they can in encouraging the use of trucks, but I would like some assurance from the manufacturers that they are going to throw a little more energy in pushing their trucks and advertising them in various cities.

Mr. Keyes, Ottawa: The instance that Mr. Dion speaks of I know to be a fact, and that electric truck man, he has done more than neglect the electric trucks, he has turned around and sold gasoline trucks, simply, I think, because it has been easier, as mentioned in one of these papers, for a man to sell a gas truck than it is an electric truck.

A Delegate: In town here there are a certain number of agents selling electric trucks and these agents generally represent a battery concern as well as truck concern. If a truck or a car of different make goes into that garage, the first thing they try to do is to put the battery out of business.

I know of two concerns here in Toronto who are using electric trucks and both concerns are well satisfied with them, with the exception that there is nobody in town who has competent—that is, practical battery men with any of the Central Stations or power company to take care of the batteries should they go out of business, and, speaking personally, I have had to bring men out of New York to take care of batteries.

Mr. Hillman: In connection with all your departments, such as lighting, motor sales and heating devices, Canada has naturally during the past 25 years been governed by results in other places. Now, if you are to compare with Europe and other places on the other side of the water, I am afraid you would not make any headway, because Canada is in advance of their progress on electric trucks. Now, is there another country that is doing anything, and what are they doing? I can simply quote the United States, if you will permit me, and I will quote from the Central Stations having a clean-cut, definite sales policy on trucks resulting in increased sales and a prosperous business. Hartford, with a population of 100,000, during the past year has sold upwards of 50 trucks, and during the month of May, 25 working days, they sold eight trucks to six new customers. Baltimore, with a population of 500,000—something like Toronto—has sold upwards of 100 trucks during the past two years.

The reason for their prosperity and large sales is because they are following the principle of guiding and leading the merchants; the same as you have all successfully followed in lighting and power and heating devices.

That one broad principle has influenced truck sales—namely, to guide and lead the merchants. I did not want to ask Mr. Merritt his argument for not guiding and leading the merchants in this branch of business that he thinks is so good, for fear that he had not studied it enough. That will come a little later. But, with Mr. Dion of Ottawa, I earnestly urge that he consider that one broad principle that has been put to such good effect. not only in the United States, but here in Canada, in connection with the lighting department and the power sales and the heating devices, introducing exhibition rooms everywhere to great advantage, increasing sales and resulting in a prosperous business by guiding and leading the merchants.

Mr. Maclachlan, Belleville: I think, with the exception of five or six cities in Canada, all the Central Stations are in small districts, and I would like to ask for some information of how the electric truck stands up on an unpaved street, or macadam. I went into the matter very fully, got in touch with the Electric Vehicle Association of America, and with a number of different men that they suggested to get in touch with, and some said, Yes, they would run over anything, and others said they would not stand up under hard usage. The district that we were thinking of putting a truck into is one that we run over pretty bad roads at times. We have gasoline truck and motor cycles on it all the time and they are standing up, but we are very chary about putting an electric truck into that class of service, and I would like to have some information from the smaller Central Stations. The conditions in Toronto, Ottawa, Montreal, Vancouver, Winnipeg and Hamilton, and some other cities do not apply in the small town at all. A man in a small town is going to go outside of that particular town with his truck, and if he gets stalled 40 or 50 miles away from a garage he is going to come home by mule power. I would like to have some information along that line, and whether the trucks will stand up under severe road conditions.

Mr. J. D. LaChapelle, Montreal: I can give you some information with reference to that. We have in the city of Montreal to-day, in operation seven electric trucks, which have been in operation practically a year. The Canadian Rubber Company are operating a truck which has been in use for 22 months, using lead batteries, and I can tell you, frankly, that the only repairs which they have had on that truck has amounted to about $25. The Canadian Express Company operate three trucks in Montreal—two 1-ton and one 3-ton. Their repairs, so far, have been on tires. The Power Company are operating a 750-pound truck since last June. That truck has been in service every day since they have had it; the average mileage has been 32 miles. The Canadian Rubber Company, with their trucks, have averaged between 22 and 30, and operated last winter and the winter before last. They lost in operating during last winter four days. Of course, the cold weather in Montreal has some affect on the batteries, but nothing like some statements made here a while ago. The power of the battery will run down quite considerably with the cold weather. It is sometimes 32 degrees below zero.

Mr. Maclachlan: The use of those batteries were over paved streets.

Mr. J. D. LaChapelle: Yes, but Montreal streets at the present time are about as bad as any streets on the continent. That is due to the result

of last winter's weather. We had very mild weather for quite a number of days and then very cold weather after that. The result of it was that the cobble stones—why, in some cases on St. James Street they actually had to knock the tops off the cobble stones, because they were touching the casing of the motor. (Laughter.)

One of the things that wants to be looked into very carefully in the Central Stations sale of trucks is to make sure to provide the owner with sufficient information with regard to his charging plant. If that is not done, the electric truck will get off in probably six months.

I can give you some figures of people who operate trucks in New York. They are operating to-day about 92 trucks, and purchased in the last five years. Their statement last year was that they saved $25,000 by the use of electric trucks. The largest majority of the big trucks in New York City are being operated with lead batteries. The lead battery has been found to be more economical and they get more power out of them, and the first cost is about one-third to one-half less than the Edison battery cost.

If anybody here would like to get some real figures as to the cost of operation of any trucks, any size, I have them tabulated, and I would be very pleased to send them to anyone. These figures are tabulated by some of the largest companies in New York City, who are in a position to give figures which they will stand at the back of. As a matter of fact, they will sell you trucks in New York City and operate them under three years' guarantee at so much a year, and the result was that the merchants operated the trucks themselves, because they found they were paying the manufacturers more money than it was really costing them.

The President: Nobody appreciates more than the speaker the regret at having to cut off this discussion.

I have a few notes which are so startling that I must ask the stenographer not to put them down as final without confirmation.

In the City of Denver, which I understand has a population of 250,000, they have electric vehicles there in the proportion of 1 to 217 people. We have here for Toronto, I notice by comparison, 125 trucks or vehicles for a population of 375,000, or 1 to 3,000. That is, the proportion in Toronto as compared with Denver, if those figures are correct, is less than 10%. In Denver they anticipate an increase in the next two years in the use of electric vehicles of 300%. I think any who are from Missouri will have something to think about as to the possibilities of the electric as compared with gasoline. It is up to every Central Station to give this question the closest possible attention. If you want to know what the revenue is—and I am also speaking from memory—the kilowatt hour consumption at Denver was over 2,000,000 kw. hrs. for one year. Take that at 3c. rate and that is $60,000 per annum, and it is practically an off-peak load. These figures are so startling that I must ask that they be not put down in the minutes until I have them confirmed.

A Delegate: They are right—put them down.

THE PRESIDENT: I might tell you of the increase in Kansas City. Two years ago they sold $17,500 worth of power, which was sold for charging electric vehicles. Last year their actual increase was $57,000.

I am very sorry we have to cut off this discussion; it is a very vital one. We must now continue to the next paper, "Service," by Stephen L. Coles, Society for Electrical Development. The paper is read by C. V. Tower, Toronto Electric Light Company.

SERVICE

By Stephen L. Coles
Of the Society for Electrical Development

Service is a fundamental necessity in the upbuilding of any public utility.

In none of the several lines of public utility endeavor is service of more importance than in the ramified business carried on by the central electric station.

For no other one business comes so near to the people as does that of the central station. It supplies light, heat and power to the home, the store, the office, the hospital, the theatre, the factory and frequently for transportation.

The successful sales manager of a central station has a better grasp of the social, political and business conditions in his community than any one else. By virtue of his position he gets a bird's-eye view of his city as a whole, and of necessity accumulates a wealth of intimate detail through his personal, direct contact with all sorts of people.

If a magazine editor, or the managing editor of a daily newspaper, had the same opportunity of gauging his public, he would forthwith produce a magazine or a newspaper that would almost eliminate competition.

The success of a central station, not only as a public utility, but as a business proposition carried on for the profit of its stockholders, is in direct ratio with the service it gives.

I do not hesitate to say that the rate of dividend is to a very great extent dependent upon the degree of service.

Naturally, perfect service is 100 per cent. efficient and we place it as the idol of our hopes on the same pedestal as the operating engineer places his ideal load curve—the straight line.

It is only within the past ten years, say, that the real importance of service has received the full attention of central station executives. The growth of appreciation of its value has been so rapid, however, that to-day we hear the officials of public utility companies strenuously urging the abandonment of the term "central station" for the newer and more appealing title "service company."

Rapid as has been the change of heart on the part of central station managers, even more sudden and surprising has been the education of the public as to just what "service" should mean to them. At the present moment, the public is quite sufficiently informed to demand and insist upon service. There is but one alternative for the central station. It must give service. Failure to do so will at once impair the good will of the company, indirectly lessen the value of the existing plant, growth and progress will halt in their tracks, and an unseen, but none the less powerful opposition to the company will be engendered. Carried to the limits, such a state of

affairs points but one way—to the chasm under the warning signboard "competition."

Any and every central station should adopt a "service" policy for purely selfish business reasons. Even a brief analysis of the question will demonstrate that the interests of the company and those of the public are identical. Therefore the central station that serves its public well, serves its stockholders and itself equally well. In these days progress in any business is founded on service.

The most valuable asset a central station can possess is the good will of the public it serves. And this good will may be increased and made to grow to a wonderful extent by constant improvement in every detail of service.

Nothing that enters into service or has a bearing upon it is trivial. The central station manager who has his mind and his eye on the little details of his business is the one who is constantly approaching the ideal of service. Nothing is unimportant that affects in the slightest degree his relations with the public.

Having established the vital importance of this matter of service, let us attempt to answer the natural inquiry: "What is service?"

One dictionary definition is: "An agency for the accomplishment of some constantly needed work, or the supply of some general and recurrent demand." The lexicographer who coined this definition easily might have taken the central electric station as a concrete example for the purpose.

Another definition is: "The act or means of supplying some general demand."

It follows, therefore, that **every point of contact between the company and a customer is an opportunity for service.** The manner in which any such opportunity is grasped is an exact demonstration of the company's ability to give service.

DISCUSSION.

The President: I hardly know whether this paper, "Service," is one that we can discuss. It seems to me that we all realize or appreciate what service must mean to any company and to the industry. The public must look to the company in any industry which is developing and growing so rapidly as that of the electric industry; the public who are not in touch with the situation must depend on the companies, either manufacturers or operators, or whoever are introducing the facilities in the field, to bring them before their attention. The public do not want to be bothered about details. They merely want service at the least possible inconvenience to themselves. We will be very glad to hear from any of our members, with reference to this broad question of service.

Mr. Maclachlan: There is one point in Service—if any of you procure "Harpers" for May and read "The Power that Serves," you will have your eyes opened. I wrote the publishers and made arrangements to have it put out in pamphlet form. It is by Alan Sullivan, of Toronto. We are putting out a thousand in our immediate vicinity. It is "The Power that Serves," by Alan Sullivan, in "Harpers," and I think the C.E.A. might do well to get in touch with "Harpers."

Mr. Magalhaes: Personally I do not like broad statements; I would like to have things detailed and made more particular. At this point I would like to emphasize the point which has been brought out before during the Convention, and that is, that service comes before rates. What is meant by service? The principal department of any Central Station is the selling department. They are the ones that get the business, and the other departments simply fill out the orders which they have obtained from the customers. There is the first place where you want service. Take a power prospect—a man laying out a factory. If the salesman that goes to him carries with him information which is correct, and which is backed up by experience, you gain the confidence of that prospect. You are giving to that prospect the services of practically a consulting engineer. The same thing is true in illumination. Your prospect, laying out his illumination for his factory or store or house, if the salesman is conversant with the general principles of illumination, it helps him out. In this town we are fortunate in having available the services of the various lamp and glassware or reflector people, who work in with us and supply that information. We do not have to worry about that end of it. The point I brought up a little while ago about vehicles fits right in in the same way. Mr. Parker, who spoke on "Electricity on the Farm," brought out that same point, that the salesman covering that class of business should be able to give something to the farmer in addition to the current which he is going to supply him later. Now, after you have got the customer—I am speaking now from our own practice here—we have a competent repair force or emergency crew, anything you want to call it, who, on a moment's notice, will step out and get a plant working again if they have any breakdown. If any of their motors are burned out, we keep a supply of motors on hand, various sizes, and we will put one in for a very nominal rent figure, and we have always found the customer perfectly willing to pay for it. We will keep him going while he is having his equipment repaired.

These are just a few of the points which we have tried to carry out here, and which have enabled us to get a higher rate than our competitors, so that we are talking from experience when we mention the fact that service should be ahead of rates.

Mr. Lambe: Mr. President, you said that you did not know whether there would be much discussion on this paper, but I would like to submit that it, along with papers such as Mr. Parker's on "Electric Service on the Farm" and Mr. Rummel's on "Electric Vehicles," are the most important that can come before a meeting like this, because they all three bear on the commercial end, on questions of increased business, your relations to the general public, etc., which to my mind are in many ways more important than the engineering features that are apt to predominate in our Conventions.

There are two or three points that always appeal to me in the matter of service. Take, for instance, the question of advertising, ordinary newspaper advertising. Now, in our household we take, I think, five daily papers, for special reasons, but in those papers there is not one item as far as I remember, saying that the electric companies are there ready to do the business of serving the general public. In other words, the general

public gets the impression that you are taking the attitude that you need not pay them any attention, because as you are the only Electric Company in town the business has got to come to you anyway. This of course produces an hostile attitude in certain sections of the community, which in turn is often apt to break out into unreasonable criticism, into demands for the introduction of unfair legislation, and finally into a cry for municipal ownership. Therefore, I always look upon newspaper advertising as most important, the simple recital of a company's name, its telephone number, and its readiness to serve, going a long way towards smoothing the path.

Another question is that of complaints. A good, live man, and particularly a polite man, at the complaint desk to receive all complaints and to say that they will be attended to, and to see that they are, is most important. You may say that if we can only shove a man off, bluff him along, jolly him, do something to get rid of him at the present minute, that to-morrow he will forget it, next day he will be done with it. Do not believe it. Mrs. Jones, if she sends in a little complaint, remembers mighty well whether it is attended to or not, and, though nothing more may be said about it, prompt attention produces a strong friend, inattention an even stronger feeling of hostility.

Then another point that occurs to me is this, namely, the business methods of your allies. A great many of you are in the same group of control with gas and street railway corporations, and your end may be beyond criticism, but if the street railway branch, for instance, be at loggerheads with the public, you also are very apt to suffer. This, I think, is particularly true of street railway work, because the public meets such a large number of street railway representatives, namely, the motormen and conductors, and on the attitude of these latter, I often think, depends to a great extent the feeling between any community and the public service corporations that are operating in it.

Mr. D. H. McDougall, Toronto Electric Light, Toronto: I would like to ask Mr. Lambe if he takes any Toronto papers?

Mr. Lambe: Toronto is all right on the advertising question.

The President: I made my remarks about this thing as not being one which is open to discussion, but there ought to be a perfect unanimity of opinion on it, that service is the essential thing to every company. We should like to have some more red-hot arguments like Mr. Lambe's.

Mr. Munro, Peterboro: This matter of service consists merely of a mass of details, and it occurs to me that it might be well to take up a few of what are apparently very small points. The first one I would like to ask is this: What is the practice of various companies in drawing the line between the attention they give inside wiring and their own distribution systems? As a general rule the company considers that it stops when the service enters the customer's premises. About six o'clock, or towards dark, possibly with the larger companies two or three times every day and with the smaller ones once every two or three days, there will be a call come in, saying, No light, in a particular house. You are almost positive it is a ground on their wiring. Do you send a man out to look after that right at

once? If he finds a ground on their wiring does he stop there until he gets it off? Do you charge them for that service?

Mr. Martin: I had an occasion of the same thing he is speaking about in my own house. I had a ground, and I called on the Toronto Electric Co.'s service, and I got it. I live two miles away from the Toronto Electric Light, and in fifteen minutes there was a man at my door ringing the bell to find out what the trouble was. I told him I could not find it. I am not a practical man, and he looked at the transformer, and he followed the line up to the house and he found that one of the main wires was ground on one of my circuits, and he told me what was the trouble, and I told him, "All right, I would get it fixed in the morning." I do not think the Toronto Electric Light Company should be expected to do that without charge. I think the man would have fixed it for me, but that is a case of service. Fifteen minutes to come 2½ miles; came up with a motor cycle.

Mr. D. H. McDougall, Toronto Electric Light: In reference to this question of customers' troubles, we maintain an emergency force night and day, available for customers. and the emergency man will trace the trouble as soon as he can and, if it is at all possible without extraordinary efforts, he will remove the trouble for the customer from his own circuits. We would rather stretch a point and do something for nothing than allow the customer to be without current or inconvenienced. In some cases we can cut out a fixture and give him light on the rest of his service, and tell him what the trouble is. I do not think we make any charge for fuses and such conditions as burnt fuse and that sort of thing, but we stretch a point where an occasion arises that will retain the customer's good will, and let him know we are out to do anything that is at all reasonable at the company's expense to give him satisfaction.

Mr. A. A. Dion: Inasmuch as Mr. Lamb has stated that Toronto was alright—that he lives in Ottawa and presumably reads the Ottawa papers, I have to take to myself most of his remarks. (Laughter.) And I think his language was rather severe when he qualified on the attitude of the companies, especially if it applies to our company. I may say we have been alive, as most operating companies are, to the importance of service, and we have tried to give it in every shape and form.

In the matter of complaints, I can say conscientiously that no complaint that ever reached me, no matter how trivial, was ever dropped until the matter was straightened out, as far as possible, and I have tried to impress that same spirit on every man in the service. Naturally the public passes over all the good things that are being done by the company with very little thought; while if a mistake is made in any one case it is taken hold of and emphasized. We like to avoid all mistakes, but it is practically impossible not to have some neglect on the part of some one employed in the service. If Mr. Lamb's remarks represent the attitude of the public in Ottawa, I think we shall have to advertise our virtues.

Mr. Lambe: I desire to apologize sincerely if I made Mr Dion feel that I was thinking of Ottawa in the sense that he took it. As a matter of fact I was thinking of conditions there, but exactly the other way round, only I did not mention them because I thought that being my home city it would look too personal. As far as advertising goes. Mr. Dion has competition,

which at once completely absolves from any suggestion even of indifference. Then as far as complaints go, I can best describe matters there by telling you of a case, only a couple of weeks old, of which I happen to know, and which I would assure you is typical of Mr. Dion's organization. A complaint was made about poor gas supply, and though the year's income from that customer was only about $20.00, Mr. Dion set to work and put in a new service that must have cost him twelve or fifteen dollars, perhaps more, when he was not, strictly speaking, called upon to make any such expenditure. Now, that is service, good service, and I take pleasure in testifying to the fact that Ottawa and the service it gets is fine in every way. (Laughter.)

Mr. G. H. Goring, Hamilton: Following up Mr. Dion's remarks, I might quote the statement that "you can never educate the public," and this appears to be borne out by events from time to time. No matter how many favors you do for them, if there comes a time when restrictions are necessary they are very likely to forget past favors.

I remember at the time the Hydro-Electric By-law was submitted in Hamilton; I think, with possibly one or two exceptions, we had all the electrical contractors against us, notwithstanding the fact that they were dependant upon us for their livelihood and that a number of them used our store-room as a convenience for buying supplies cheaply and quickly, and are still doing so; the fact that we sold supplies to everyone at a very reasonable rate seemed to bring out the animosity of the wiremen, and we could not persuade them that our actions were adopted as a "public service," and we were simply doing what other companies, in other places, were doing to promote a more general use of electricity.

The President: I think there is one thing we all realize—there is an awakening of public opinion; not that alone, but an awakening in the Central Station companies.

Mr. A. A. Dion: The last speaker has opened up a very important question, one that was debated at the last Convention of the N.E.L.A. at Chicago—the relations of the operating companies to the wiring contractors. In our city we have kept in our Sales Department not merely appliances but a full line of electric fixtures. We do not do wiring. We sell supplies. Several times a question has come up, whether we should abandon the sale of fixtures. And the main reason for retaining that department has been that no one in the city kept a sufficiently varied and extensive stock, especially in the higher class of goods, to satisfy the demands of the public and enable them to buy their supplies without having to go out of the city. But that has had the effect mentioned by the last speaker of incurring the enmity of some of the wiring firms. This is a serious matter where you have competition, and for that reason we have considered at times whether it would not pay us to abandon this department in order to gain the goodwill of the contractors.

At Chicago I met Mr. Pack, whom most of you know, recently of Toronto but now with the Minneapolis General Electric Company, and he told me that that company, after due consideration, for the reasons I have stated, had decided to abandon entirely the sale of everything—fixtures, shades, appliances and even lamps. They had called a meeting of the contractors,

had invited them to a dinner party, and at this meeting they had discussed the situation. They had told the dealers that they had decided to go out of this business, and that as long as the dealers would keep a proper assortment and sell at a reasonable price, and sell the right kind of lamps and fixtures, the company would remain out of the business.

I found, however, in the discussion at Chicago that the majority of the companies were of a contrary opinion. They thought that, as far as the appliances are concerned, as distinct from electric light fixtures, the companies should handle them.

Now, this is a very live question with us at the present moment, and it would be of very great assistance to us if we could get some expression of opinion along that line from some of the operating men here.

Mr. McAlister Moore, Belleville: From the manufacturer's point of view I would like to reply to Mr. Dion. If you will take Bradstreets and look up the electrical contractors and see how many contractors have a satisfactory rating, you will have a mighty good indication of what could be done. I might say in this connection, on looking over the City of Toronto there are more contractors in this city with a satisfactory credit rating than any other city in the United States or Canada of its size that I know of.

D. H. McDougall, Toronto Electric Light: You do some things you would not do if you were not in competition. The good will of the contractors is a very important item in our business. I think the contractors in Hamilton, that have been recently censured, were only looking after their own business. They wanted competition and competition means more work for them. I do not think they are entirely to be blamed. The good will of the contractors is a very important item in the operation of a Central Station.

Now, the Toronto Electric Light sometime ago went out of the sale of fixtures. They do not sell any fixtures at all except appliances and that sort of thing. We sell a few lamps and we rent a few fixtures. We do no interior wiring.

We recently issued a pamphlet, a Bulletin—of which a supply has been placed here for your perusal—and of that Bulletin we circulate about 25,000 each month to our customers, prospects and to the people whom we think are interested; we advertise a list of wiring contractors. We co-operate in every possible way with the Contractors' Association. We offer a schedule of prices for wiring houses and advertise about wiring houses at certain periods of the year. We turned over a list of 300 live prospects to the Contractors' Association recently; made a house-to-house canvass for certain new appliances, and found houses not wired and handed those over. We quote rates already quoted to us by the Association. We make the Association, as far as possible, live up to first-class work in every respect, because the company is more or less behind the contractors in that respect, having quoted the price in the first place. Recently in New York there was organized what is called the Electrical Development Society. Mr. Coles, who wrote this paper, is about to be taken on their staff. They have not fully organized yet. He has been retained by them, but we have engaged him for a period of two or three months to organize our advertising and to start this periodical.

Mr. Coles is a man of very great experience in electrical work, writing and journalistic work. This new Society had an organization meeting, contractors, Central Station men, jobbers and others interested, and at first it seemed as if they never could get together. The contractor got up, the supply man got up, and said Central Station should not sell anything. And one man even said that he could outsell any Central Station, that they would not buy things from them, that Central Stations had a bad odor in a community and that supply men had advantages that a Central Station man had not. And Mr. Doherty, who is a leading operator, got up and said the supply man could put in a supply store next to his Central Station and he, the Central Station, would sell three times as many goods, because it was not true that the Central Station had not the good will of the community. That was where people came when they wanted information about supplies, and he had generally found that the best way to retain the good will of the supply man was simply to sell goods on a good sound merchandising basis, that would give the contractor a chance to earn a fair profit and not cut in his business by cutting rates, which a company could afford to do and contractor could not. And it was practically decided among the Central Station men, and particularly of this company, that that was the best policy to follow. And in cases of special sales, contractors' supplies, the contractors are supplied with special appliances so that they could make a reasonable profit on a special sale. I feel sure by doing that we can co-operate with the supply men and contractors and give service to the public. The main thing is to get the public to use every appliance and modern equipment as soon as we possibly can.

Mr. G. H. Goring. I would like to correct that impression, as that was not the idea I wished to convey. I was simply stating what we, as a company, were doing in the way of providing "public service."

We considered that we were serving the citizens in the best way possible by selling these supplies cheaply. We sell at a small profit, but the dealers are all of the opinion that we should not sell supplies at all.

Mr. Maclachlan : I would like to request that Mr. Ostram, who is a guest of this Association, and who has been in the wiring business as a contractor, be asked to make a few remarks. Possibly he may have that point of view that would be of assistance to the operating men and manufacturers here.

Mr. Ostrom: We have been operating six branches in that territory Mr. Maclachlan speaks of, and the attitude of the Central Stations when we first opened our branches, we thought, was antagonistic to the contractors, but the troubles mostly arose from customers whose services were discontinued by grounds or blowing fuses, etc., and by complaints concerning these matters not coming in until toward evening. Not very many contracting firms in small towns such as we operate in have telephones in their employees' houses, and for that reason when complaints re blown fuses, etc., came to the Central Station they telephoned to me, and I was not so keen on their service, so far as putting in fuses was concerned, to personally attend to each customer, and the result was that in these towns for quite a long time after we went into the business a good many customers were

without service some nights. But the thing was remedied, first in Belleville, owing to the local manager there taking the attitude that they, the Central Station, should give proper service, and customers were gradually educated up to the point that if they had any complaints they should get them in before dark, before our employees left. After several meetings with the local managers in our other towns and working on schemes to get over these troubles, we set aside a man in each town to look after complaints, and found that the revenue we got from attending to these complaints not only paid for the man's wages but netted us a very handsome profit in nearly every case. The whole question of service, so far as the relationship between the contractor and Central Station is concerned, appears to be that the Central Station show no discrimination whatever as between contractors, and give the public to understand that when their complaints are in in time they will be properly attended to. In this way most difficulties are overcome as between the contractor and Central Station. And I can say so far as the contracting business is concerned in the territory I am connected with, from Oshawa to Napanee and north as far as Lindsay, that the relationship between the contractor and Central Station is now absolutely ideal.

The President: I would like to hear from some of the manufacturers; they come in contact with both Central Station and supply men.

Mr. Brown: When we supply material with our name on it, occasionally users of this material call up the office—having forgotten in the meantime from whom they purchased the article—and in the city here particularly we are very frequently called up about trouble. In all these cases we simply refer them to their respective current supply organization and find that they get very good attention. However, until the last few months, it seems that the general public have not been educated to appreciate the advantages of the Central Station Service Department, and I think the remarks made by Mr. Lambe in connection with advertising these features of the Central Station in the local papers is a most important one.

It appears to be an important thing to educate the general public as to just who to look to in case of trouble. If it is the Service Department of the Central Station. I think that point should be brought foremost in the local papers. If it is the contractor, by arrangement with the Central Station, who should look after the trouble, I think that point should be brought to the attention of the public.

Mr. D. H. McDougall, Toronto Electric Light: I would just like to say one word, and that is, one reason the Central Station is forced to maintain these emergency crews to repair motors and do a great deal of work they have no desire to do—that is, there is not such a thing as an emergency outfit among the contractors in Toronto; they do not cater for that kind of work because they do not appreciate how much is in it. A good live emergency contractor in Toronto to-day, with men on day and night, it would be a good thing indeed.

Mr. Brown: I would just like to ask Mr. McDougall if it was ever advertised in the papers as to this Service Department. I have noticed a good many notices in the local papers about new devices, but I have never

seen advertised the Service Department and the fact that the local company are ready to serve in this way.

Mr. D. H. McDougall: In reply to that, I think in the first issue of our company Bulletin, which went to all our customers and others, that there was an article stating that we were always at the service of our customers and we maintained this organization.

I do not know whether I ought to expose the position of the company at present, but we have been undergoing extensive alterations and repairs in the way of additional batteries and plant, two more circuits from Niagara Falls, because our load has grown so that it is a very difficult matter to maintain a perfect service, and a shut down at Niagara means a good deal in the service. So that we have not been advertising to any great extent that we are in a position to give perfect service, but we are sticking to flat irons and various things of that kind to get over until about the 1st of August when we will be able to talk pretty big. I do not think there is any customer we have got that has not been made aware of the fact that we have an emergency force ready at any time to look after his troubles as far as possible.

Mr. A. A. Dion: I think the secret of advertising is to keep after these things. Mr. McDougall has mentioned that this fact was brought forward in their first issue of the "Bulletin." That is all very well, but the general public forget very soon. I think the fact that they are ready to replace fuses and trace up grounds, etc., should be brought to the general public's attention at least once in two weeks.

Mr. Harris, Toronto Electric Light: There is one point I would like to bring out about the Central Station having an emergency department, and not giving it out to contractors in case of emergency. The reason for that is that our men are familiar with our net work of wires. Generally, the cause of the trouble comes in in the afternoon, and our man goes up to get the trouble, and he finds that it is an outside trouble, and he knows just what to do in a case of that kind, and it gives us a chance of fixing that before dark; whereas if you get a contractor there is time lost in doing so. Again, if they call up after dark, our men know what to do, for the simple reason they have access to our service boxes, which are sealed. They have access to the service boxes, whereas the contractor has not that permission. And that is the reason why we keep up an emergency department. I think we keep it up twenty-four hours of the day; we have men to go out any time of the day or night. That is our reason for doing so—he gets that trouble much quicker.

The President: I do not like to close this discussion. The time is now at an end for this morning's discussion, but if there are any vital questions which you want to bring up in the afternoon, it would be a very good opportunity to do so.

I have a letter from Mr. John Murphy, a very active member in our Association, who sends his regret from Ottawa of his inability to be present. Also a letter from Mr. Gaby, Chief Engineer of the Hydro-Electric, in reference to the Hydro-Electric Inspection Rules, offering to meet a Committee from this Association on any question affecting these rules. The following Committee has been appointed: Mr. A. L. Mudge, Electric

Power Company, Toronto; Mr. Angus, Hamilton; and Mr. F. J. Clark, Toronto Electric Light Company. These appointments will be subject to the approval of the incoming administration. I think they should get active right away to look into these rules. These members are picked from Toronto and Hamilton for the reason that they can get together and act quickly. There is nothing to keep them from adding to their number.

Mr. McDougall's paper will remain over until this afternoon.

Meeting adjourned at 1 o'clock.

THIRD DAY—AFTERNOON SESSION.

Friday Afternoon, June 27th, 1913.

On resuming at 2 o'clock.

The President: As I announced this morning, on account of the lateness of the proceedings, the paper "Central Station Advertising," by D. H. McDougall, Toronto Electric Light Company, was postponed until this afternoon. It will now be read by Mr. McDougall.

CENTRAL STATION ADVERTISING

By D. H. McDougall
Of The Toronto Electric Light Co., Limited

A central station company's business can be defined as selling profitably electric service.

Before selecting the best let us first endeavor to classify the various possible methods of advertising.

The methods or mediums of advertising may be divided roughly into two classes:

1. By direct contact with the public.
2. By printed advertisement.

In effective printed advertisements let us borrow two axioms:

1. The advertisement must be read.
2. The advertisement must be true.

In order to make an advertisement attractive enough to be read sometimes the second axiom is stretched nearly to the breaking point, but a company that is in a permanent business cannot afford to forget the saying of Abraham Lincoln, "You can't fool all the people all the time." When the public find that there is anything extravagant about a company's advertisements, they grow suspicious of the company itself, and consequently, the result is apt to be detrimental instead of successful or impressive.

The first division of advertising can be divided into:—

1. Delivering the goods.
2. Courtesy to the public at every point of contact.
3. Direct personal canvass.
4. Periodical visits to consumers to solicit criticism and forestall complaints.
5. Prompt and cheerful attention to complaints of consumers by means of an efficient emergency force.

In considering the question of advertising and the best methods of securing results, we would undoubtedly select the methods classified as Direct.

The printed advertisements of all classes, as we said above, must be true to be successful, and how can they be fruitful if the goods are not delivered, or only partially delivered?

No matter what the printed ads. can say, how long would the consumer remain (if he has the option of changing his service) if every time he has occasion to come in contact with the company, or with an employee of the company, he is met with brusqueness and antagonized?

Every employee of the company is a medium for advertising the company by his or her courtesy and efficiency. Possibly next to the actual delivery of the goods, courtesy is the best method of advertising the company's business.

The direct personal canvass by agents, salesmen or other canvassers should be of next importance in considering methods of advertising. This, of course, depends to a large extent on the efficiency of the company's representative. It also depends, like the printed advertisement, on the truth of his statements.

If a salesman secures a contract on the promise that a service will be installed in 24 hours and by reason of his having overlooked the fact that no standpipe has been erected and the consequent delay is one week before the service is installed, the advertisement secured by the agent is liable to be detrimental, and in the same way if the agent promises service in 24 hours and by reason of the inefficiency of the service order department, or the service department, or any other department of the company, the installation is delayed, the advertisement is a poor one. A poor ad. is worse than none at all.

In the same way every employee, whether telephone operator, complaint clerk, demonstrator, billing clerk, office boy or delivery driver, can advertise the company by accuracy, courtesy and efficiency, probably with better results to the company than any printed advertisement.

The complaint department is one of the most important branches of the business, as it is through this department that the customer probably comes most in contact with the company, and by the treatment and manner in which he is met he forms a large part of his opinion of the company's efficiency. A company should select with greatest care the representatives to handle its complaints, and should look to these representatives for an advertisement of the business.

Having said so much for the means of advertisement classified as Direct, let us turn to the second division, namely, Printed Advertisements.

There are several methods of printed advertising which might be classified in the following order of importance:—

1. Direct advertising, by which is meant a company magazine (or house organ) published monthly, circulars, letters, pamphlets, etc., sent direct to ascertained prospects or others it is desired to interest.
2. Daily newspaper advertisements.
3. Bill board, street car and electric sign advertising.
4. Weekly papers or magazine advertising.
5. Theatre programmes, charity and entertainment programmes, etc.

We have selected as of first importance in the printed advertisements what is known as direct advertising, that is, by means of the house organ, circulars, circular letters, pamphlets, etc. mailed direct to ascertained prospects and others it is desired to interest, because His Majesty's mails are pretty reliable and the company can be reasonably sure the printed matter will arrive at its destination.

We have quoted the axiom in referring to printed matter, that it must be read to be effective, and, of course, this is true of circulars as it is of newspaper advertisements.

By careful composition and selected and tastefully set up matter, a magazine, circular or pamphlet can be made so attractive that it will not

only be read, but, if sent out regularly, be looked for. The amount of ignorance, or, shall we say, the lack of knowledge of things electrical displayed by the public is astonishing to the initiated, and the field for the dissemination of primary or rudimentary electrical information is very favorable to the electrical companies. If this field, ready for the sowing, is carefully cultivated and the planting is done with selected seed of a simple and understandable nature, the resulting harvest should be an ample reward for the workers.

Somebody said: "Wisdom is humble because she knows no more," so great care must be taken in all advertising not to show an overbearing or exalted attitude toward those less informed.

By means of attractive literature that will be read, more good for the company can be done than by any other means of printed advertising, always provided the articles are true.

The daily newspaper advertisement can be made next effective if the reading public are at all sympathetic or interested in the company, but as a means of converting an antagonistic public, it is of doubtful effect, unless the papers themselves are fair or, at least, unbiased toward the company.

A small antagonistic news item in the same edition as the company's advertisement will, to a large extent, neutralize the effectiveness of the carefully prepared ad.

The next method of importance in our opinion is that of bill board, street car and electric sign advertising. Possibly the electric sign should be placed first of these three, as an electric company should endeavor to practice what it preaches. On the other hand, the electric signs, especially the flashing enormities that are seen in New York and other large cities, are better adapted to advertise manufacturer's articles than a central station service. We believe that dignity is lacking in many of the modern signs, and the flashing qualities are a detriment and more or less objectionable from our standpoint where service and steadiness without flamboyant and spread eagle boastfulness are to be accentuated.

Bill boards properly illuminated should be a good medium of advertisement, provided they are made attractive and pleasing to the eye and and made up so that he who rides may read.

Street car advertising is more or less effective, but is more adapted for appliance advertising than for any other branch of our business.

The fourth division, weekly papers and magazines, are much in the same category with the daily newspapers, except that they are liable to be read on Sundays in the homes and less hurriedly than the dailies, but, if the editorial departments are antagonistic, their efficiency is largely weakened.

The other methods of printed advertising, namely, theatre programmes, baseball score cards, charity entertainment programme ads., etc., give probably less results than those previously mentioned, but, if the material is carefully compiled can be made of some benefit to the company.

On the whole the best method in our opinion of advertising the company's business is service, by which we mean delivering the goods in every branch of the organization with efficiency and courtesy.

The President: Before discussing Mr. McDougall's paper, we have a report here of the Commercial Committee of the Canadian Electrical Association. Will Mr. Pratt read the report of the Commercial Committee. It is very much in line with the paper "Central Station Advertising," and any discussion can take place on the two.

Mr. Pratt, Hamilton:

THE REPORT OF THE COMMERCIAL COMMITTEE OF THE CANADIAN ELECTRICAL ASSOCIATION.

Your Committee in the past year have held meetings and have kept in close correspondence during the year. During the latter part of April we sent out a circular letter, asking for certain information that would be of interest to the men connected with the Commercial Departments of the different Central Stations. We have received a number of replies to this circular letter, and intend having these replies printed verbatim and forwarded to the different Member Companies after the Convention. This was decided upon after going over the replies in detail, as we thought that although some replies might not be of direct interest to the Committee, yet there might be some Member Company to which this reply would be of great value.

In going over the replies sent in, one is immediately impressed by the fact that the problems before the large Central Stations are of an entirely different nature from the problems before the small Central Station. The large Central Station covering a large area naturally employs a great number of men, and can afford to have a department who can give their whole time to the commercial side of the Central Station work. This department has before it problems of organization, and reports that hardly apply to the small Central Station, the Commercial Department of which is simply part of the work of the manager and his employees, who only give part of their time to this work.

One is also impressed by the fact that although great sums of money are paid annually for advertising, yet there does not seem to be any workable way of checking up the results. Also statistical records with regard to the progress of the Company and town, in which they are located, are not used by a great number of the Companies. This no doubt is due to the fact that many other problems of possibly more importance have been presented, which have had to be solved, and this problem has been left to the future.

It has not been thought advisable to bring in a complete report at this time, due to the amount of work that is before the Convention, but when the Member Companies receive the copies of the letters that we have received, we think that they will be put in touch with some very valuable information.

Submitted in behalf of the Commercial Committee.

DISCUSSION

Mr. L. W. Pratt, Hamilton: While I have the floor, if it is in order, I would like to ask Mr. McDougall one or two questions.

THE PRESIDENT: The paper "Central Station Advertising," and Report of Commercial Committee, is now open for discussion.

MR. PRATT: I would like to ask Mr. McDougall if his Company have made any effort to determine the amount of direct good or number of inquiries from the monthly Bulletin which they send out? And the other question that has occurred to me: Does the newspaper advertising which his Company engage in, stimulate advertising on the part of his direct competitor, the Hydro System? And if so, if it has resulted in an advertising war at a very considerable cost for that form of advertising?

MR. D. H. MCDOUGALL: In regard to the Bulletin, the month of June was the first month published. We have not had any opportunity of getting any line on the effectiveness of it. We know that it has done good. We know that we have had very favorable comment from our customers. Only yesterday we sold a washing machine for $120 cash from the result of our Bulletin, the first issue of the Bulletin, direct result. We have the experience of Brooklyn, N.Y., and those other places that have published these Bulletins for some time. In New York, the Edison Company, I think, has published a monthly Bulletin since 1903, or perhaps before that. They look upon that as one of the best means of keeping in touch with their customers.

In reference to the newspaper advertisements, we have last year—I think it is not disclosing any secrets—spent $20,000 in advertising in the papers. The result of that has, in our case, been unfortunate because of our service. We had a lot of line trouble and other things, which we are spending a lot of money, some $3,000,000, to remedy. Our spending this money in advertising was very much invalidated by the results of service. And, as I said in my paper, service in my opinion comes first, from our experience. It has not provoked an advertising war. Our competitors have a regular appropriation that they make for advertising, and it has to go through the Commission. That is where a company seems to have an advantage over a Commission ruled body. They make their appropriation a fixed amount. They generally submit the advertisements to the Commission for approval before publication, and sometimes have a whole series prepared definitely before they are authorized. With the company they are mobile. They can take advantage of a local situation, or of an opening of some kind, or they can act very much quicker, in my opinion, than a municipally controlled company. We have not seen any results from our advertising in the way of competition in advertising. We understand that the Hydro of Toronto had their campaign planned before we did, and, owing to both conditions, we decided to get a little more aggressive. We employed a man who was an expert in his line, and have spent probably twice as much in the last four months in proportion to monthly accounts for advertising than formerly, with the idea of getting more aggressive. That had no possible effect on the advertising of our competitors.

MR. E. T. GARNER, Toronto Electric Light: As a representative of the company, I might say five contracts have been secured since last month between the first and second issue of the organ by myself in this particular instance. I find it had quite a helping hand to us fellows

going through the city, and if carried on more extensively by other Central Stations they will get the same results.

The President: What has been done in Hamilton, Mr. Pratt?

Mr. Pratt, Hamilton: For the past three years we have issued a small monthly Bulletin, a four page publication, about four inches wide by six inches long, in which we usually place on the front cover an attractive picture showing a young lady operating an electric iron or chafing dish or curling her hair. And on the inside we show various devices and describe methods of utilizing our service. Sometimes we publish a list of wiring contractors, and give the prices of our Tungsten and carbon lamps, and endeavor to set before the public the great benefits to be obtained by using appliances. Our appliance department is doing better and better every month, and during this year we have very nearly quadrupled our sales over the corresponding period for the previous year. It was due to the fact that we have not been able to trace the amount of good from the bulletins that I asked Mr. McDougall that question. I am quite convinced it is one of the very best forms of bringing before the public the advantages of proper utilization of electrical service after you once get it into your house. It does not do very much in the way of getting new business because it usually goes to old customers, but in developing business it is of very great assistance.

Mr. D. H. McDougall: I would like to point out in reference to the last remark made by Mr. Pratt, that we not only send these to our own customers, but we send them to every possible prospect; keep close to our prospects. And we endeavor, as far as possible, to get a list of Hydro customers, to supply them regularly with these Bulletins, not only for our good but for the general benefit of the use of electricity.

Mr. McIntyre, Ottawa: We do considerable advertising, using bill boards, newspapers and our windows, also sending out booklets and enclosing pamphlets in our monthly accounts. This year we discontinued the use of bill boards, our reason for this being that during the last year for three months the McClary Manufacturing Company used a full sheet poster, posted around the town in 25 good locations, advertising the combination gas range "For sale by the Ottawa Gas Company." During that period we had not one call for them. Anyway we did not handle the stoves ourselves. We therefore decided, in view of this experience, that this year we would not do any bill board advertising.

I notice Mr. McDougall has not touched on window advertising. That is one thing we lay particular stress on. In fact, if we had to decide on stopping either the newspaper or window display, I would certainly recommend the stopping of the newspaper advertising and continuing the window displays.

There is one thing about which I would like to ask Mr. McDougall, that is, novelty advertising. At the Chicago Convention the general opinion seemed to be that novelty advertising was a waste of money—money thrown away. Now, in Ottawa at the present time I do not think it is. It strikes me as a very good way to get into touch with the contractors and architects, and as something which creates a friendly feeling, which is undoubtedly a

very valuable asset to the company. I would like to ask Mr. McDougall what is his opinion of novelty advertising.

Mr. D. H. McDougall: I confess I absorb a good deal of the sentiment of the N.E.L.A.—that novelty advertising is not as effective as the same money spent in other ways.

I wish to say, with regard to the window advertising, that we quite agree that it is probably one of the most effective ways of advertising, and we endeavor to make our showrooms and windows as attractive as possible. And we contemplate some extensive changes to get better results in that way; but as far as novelties go, we have never taken them up, have never considered them of very great benefit, and the revenue of the company in competition—I think our competition here is keener than probably anywhere in America—limits the amount available for advertising. We feel that we have got to get absolute returns for the money invested, and sift out the methods so that we can get the most effective ones. And I think that the speaker is quite correct in saying that window advertising probably is just as good or better than newspaper advertising. We have a special reason for being a little more aggressive with our newspaper advertising than we probably would be. We debated for two or three weeks as to the advisability of withdrawing every newspaper advertisement we had and sticking to our house organ and direct circulars and pamphlets; but, owing to present conditions of the situation here, why, we decided it was an opportune time to be perhaps a little more aggressive than usual.

The President: Any further information to be given or received with reference to either of these two branches of advertising? If there is no further discussion on this matter we will now proceed with the reading of the next paper.

A Delegate: Going back to the matter of service, it was said this morning that the companies should advertise the facts that they have emergency departments and so on. I would like to ask if it is not an important thing to increase or improve the personal contact between the companies and the consumers. Of course we all recognize now that the office boy is not the right person to answer the 'phone and that sort of thing. But going further, the meter readers, for instance: Why not instead of endeavoring to get a man who is capable of reading meters and no more, therefore not worth any more pay than that, get a man whose personality is such that you can trust him to give the company the very best possible representation in the very intimate contact which he has with its consumers once a month. I would like to know if any of the companies have taken up that matter at all? Are the Toronto Electric Light Company issuing any special printed matter or advice to their employees, or anyone in connection with the company who comes in contact with the public, to see that they represent the company's point of view?

Mr. D. H. McDougall: I might say that I do not believe we are as yet, but we have a very active company section of the N.E.L.A., and by means of these meetings we endeavor to keep up the enthusiasm and solicit enquiries of the difficulties of our salesmen or anybody else connected with the company, and get a good deal of useful interchange of ideas. The company section can be made of great use to your advertising agents. It is one means of his understanding the difficulties or understanding the problems that have to

be faced. We feel that the company section is of great benefit to the company, and if you cannot get a company section you can have a monthly meeting of your employees of some kind, make it interesting to them and make it an object for them to be there. We endeavor to get our chief engineer and Mr. Hood, our distribution engineer, and our salesmen and all the different departments together, as by doing that we secure better co-operation. There is always a tendency in a company in the emergencies and difficulties that arise—especially a large company—for salesmen to blame the distribution or distribution to blame the service order department, etc., and not exactly to shift the responsibility but to think that they are not entirely to blame. That is very often the case, and by interchange of ideas on educational lines we are able to eliminate somewhat the disgruntled feeling between the departments and bring about a co-operative effort that is bound to result in benefit to the company at large.

A Delegate: I might say in connection with the meter reader, that he carries a card for incoming or outgoing tenant to the effect that should a tenant move into the house he signs his name to a small card to the effect that he wishes to continue the T.E.L. service. That is turned over to the contract or sales department, which in turn is turned over to salesman in the district, and we find that quite a help to us. Also we have a card with a small piece of string attached, which we tie on to the meter to the effect that T.E.L. service is in that building and if they will mail the card to us we will have a representative sent up at once to cut the service on for them immediately that night.

The President: We will have a paper by Mr. C. E. Sisson, Canadian General Electric Company, "Pole Type Transformers."

POLE TYPE TRANSFORMERS

By C. E. Sisson
Of the Canadian General Electric Company

In this paper, attention will be called to some of the more important details entering into the design and construction of the modern lighting transformer, both from the operator's and the manufacturer's point of view. It is hoped that some of the points touched upon may call forth a discussion which may result in arriving at conclusions that will be of mutual benefit.

It is approximately twenty-five years since the first commercial lighting transformer was put into service, and the design of this kind of electrical apparatus has undergone very many changes since that time. These changes have been brought about by the competition of manufacturers, demands of operators, increased knowledge and experience of designers, together with improvements in materials at manufacturers' disposal. However, the essential features of a lighting transformer have remained the same, which in the order of their importance are:

Safety,
Durability,
Economy of Operation,
First Cost.

These features are very closely interwoven, and too great sacrifice of one on behalf of another is not to be encouraged. There is a temptation on the part of the manufacturer, due to competition, to sacrifice the first two qualities for cost; while the purchaser may also be inclined to give first cost too great consideration.

Safety, durability, and economy are of course dependent upon: Insulation, Ageing, Temperature Rise, Core Loss, Copper Loss, Regulation and Magnetizing Current.

Safety, which depends upon the durability to some extent, but particularly upon the insulation between the high tension and the low tension and core or ground, should receive prime consideration, as both manufacturer and operator are morally interested in this characteristic of a transformer. It should not be considered sufficient that the insulation at the points mentioned should stand up under ordinary conditions or during factory tests; but it should be of such material that it is practically indestructible, as the greatest risk is experienced when the fibrous insulation, some of which must be employed, has been destroyed under abnormal conditions,

such as a burn out from over-loading or an external fire. Insulations are in use which approximately meet these requirements; but they are very few. Experiments and actual experiences have shown such insulation to remain in place and properly insulate the low tension winding from the high voltage after the apparatus had been tested to destruction or destroyed in service.

Durability: Closely interlinked with safety, since they are both dependent upon the life of the insulation, are the questions of durability, reliability or longevity of the transformer. The manufacturer is perhaps not so much interested in the long life of a transformer, except in so far as it affects his reputation of which he is naturally very jealous. But it is to be feared that many purchasers of lighting transformers have not given this feature sufficient consideration in comparison with cost or efficiency. From an operating point of view, reliability is of the greatest importance, as upon it depends the continuity of service with which goes the satisfaction of customers; while from an economic standpoint it cannot be ignored as it determines the rate of depreciation that should be placed on equipment. This question has not received the attention it should, possibly because our distributing systems have not been in use for a sufficient length of time for us to become thoroughly aware of its significance; while the low losses of the present lighting transformer justify its being kept in service longer than was justifiable with the old and less efficient apparatus. However, it may be readily determined how important the lengthening of the life of a transformer from ten to twenty, or from fifteen to twenty years is, and with the cost of energy materially reduced, due to developments in generating plants, the item of depreciation demands more and more consideration.

The importance of this question of durability will be dwelt upon at greater length towards the end of the paper.

The reliability of a transformer depends upon the use of proper insulating materials, their judicious arrangement, and guarding against excessive temperatures and irregularity of heating or hot spots.

Insulating for Durability: It may be of some interest to review briefly the steps taken by manufacturers to obtain the present high efficiency of insulation. While it might be attempted to insure safety and reliability by the addition of more insulation, this would have the objection of resulting in increased cost and an increase in the degree or non-uniformity of heating that would more than counteract the advantages hoped to be obtained. We must, therefore, if our apparatus is to be more reliable, turn our attention to a better arrangement of parts and the selection of a better and more suitable method of insulating. The insulation must be free from, and protected against, the absorption of moisture, in addition to having dielectric strength sufficient to withstand normal strains of operation and test voltages required. Such materials as paper, cotton, cambric, etc., have been found of great value and are universally used at certain points in transformers; but, while they are good insulators when dry, they absorb moisture very readily. To guard against this, use was made of different liquids which were adopted on account of their moisture-excluding qualities. However, this method was objectionable in that too much dependence had to be put on the workman; while the liquid insulations tended to seal in the coil, whatever moisture was present when they were applied, and in many cases were not them-

selves hygroscopic when they dried out. Realizing this, some manufacturers avoided the use of insulating fluids and depended upon the oil keeping the moisture out of the insulation and winding, after it had been previously driven off by heat. However, this had its objections in that it was difficult to remove all moisture without raising the temperature to such a degree that there was danger of injuring the insulating materials and also it was impossible to protect the apparatus against moisture during the time between completion at the factory and installation.

The idea was conceived of drying the transformer coils and sealing same with a compound which when hardened at a temperature above that at which such apparatus is usually operated, would exclude all possibility of moisture re-entering the winding. This resulted in the development and adoption of the process employed by many manufacturers at the present time. This consists of drying the apparatus under a vacuum to assist in the removal of moisture at a lower temperature than would otherwise be possible, and thus avoid injuring the fibrous insulation, and then filling same with a compound which will harden under normal conditions. This treatment transforms the otherwise spongy mass of copper, cotton, and cloth, from the innermost pockets of which it is otherwise impossible to remove the moisture, into a solid mass capable of resisting mechanical injury, protected against vibration of parts and completely sealed against the re-entering of moisture. The compound employed should be a good insulator, should not be attacked by the oil employed, should be a good heat conductor, should be mechanically rigid and have as high a melting point as possible.

Heating and Durability: Of course it is readily recognized that excessive temperatures have the injurious effect of ageing the fibrous insulation, which ultimately results in its breaking down. However, care must also be exercised in guarding against unevenness of temperatures or hot spots, as same results in the moving of parts with respect to each other, causing an abrasion of the insulation between these parts. Too much importance cannot be attached to this question of uniform temperature, as the results of a heat run, which give the average temperature, may show a transformer as meeting a certain limit, while at the centre of a large mass of unventilated and spongy winding, a dangerous temperature may have been reached.

The compound filler spoken of above serves the additional and very desirable purpose of readily conducting the heat to the surface of the winding; while uniformity of heating is obtained by the proper proportioning of parts and the breaking up of the otherwise large masses of windings in such a way that the cooling medium can readily be brought in contact with a great deal of the winding by means of oil ducts, etc.

Economy of Operation: That the cost of losses is an important consideration in selecting a transformer, is quite evident, and in fact approaches a value equal to that of the transformer itself. With the marked improvements in the quality of steel and the adoption of more economic designs, the losses in the present type of transformer have been materially reduced until for a given Kv-a rating they are the most efficient piece of electrical apparatus built.

The curves shown give a very good idea of the remarkable improvements in the characteristics of distributing transformers from 1896 to the

present time. The improvements in the efficiency at light loads illustrate very clearly the effect of the reduction in core losses, while the improvement in regulation is accounted for by the reduction in copper loss. It will also be noted that a decided improvement has been made in the regulation

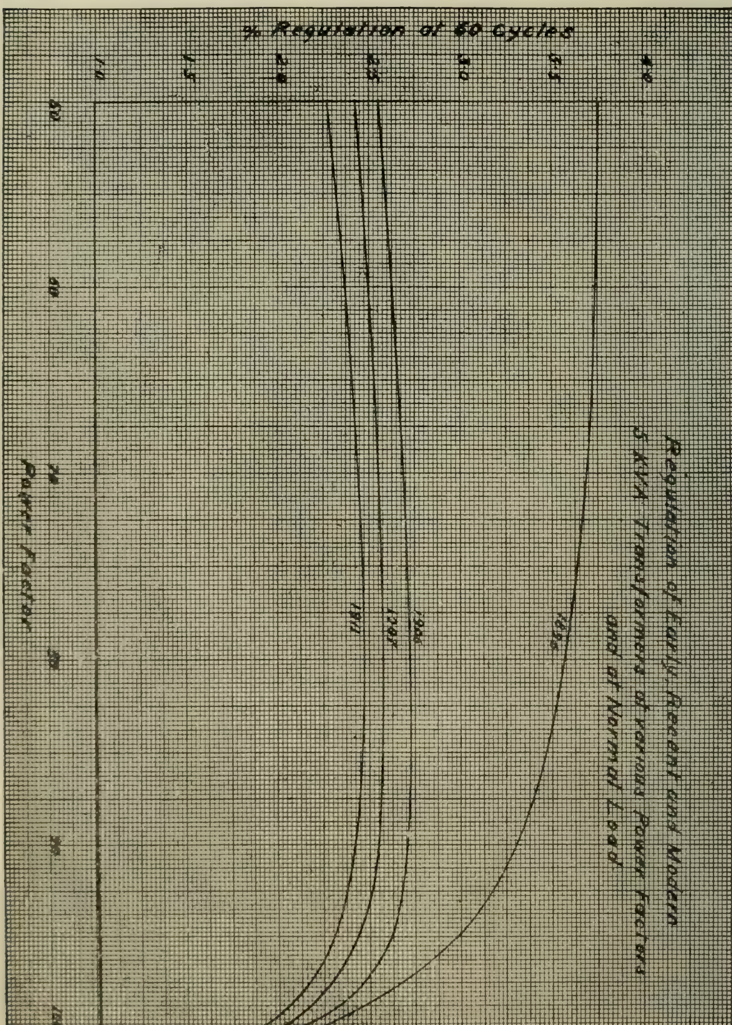


Fig. 1

at low power factors, as illustrated by the figures for a 5 Kv-a transformer. These curves have all been taken from the characteristics of one build of transformers.

Such marked reductions in losses combined with the better mechanical construction of the newer types have made it necessary to place a very high depreciation value on the older apparatus installed. This depreciation is more than offset, however, by the decrease in the annual cost of core and

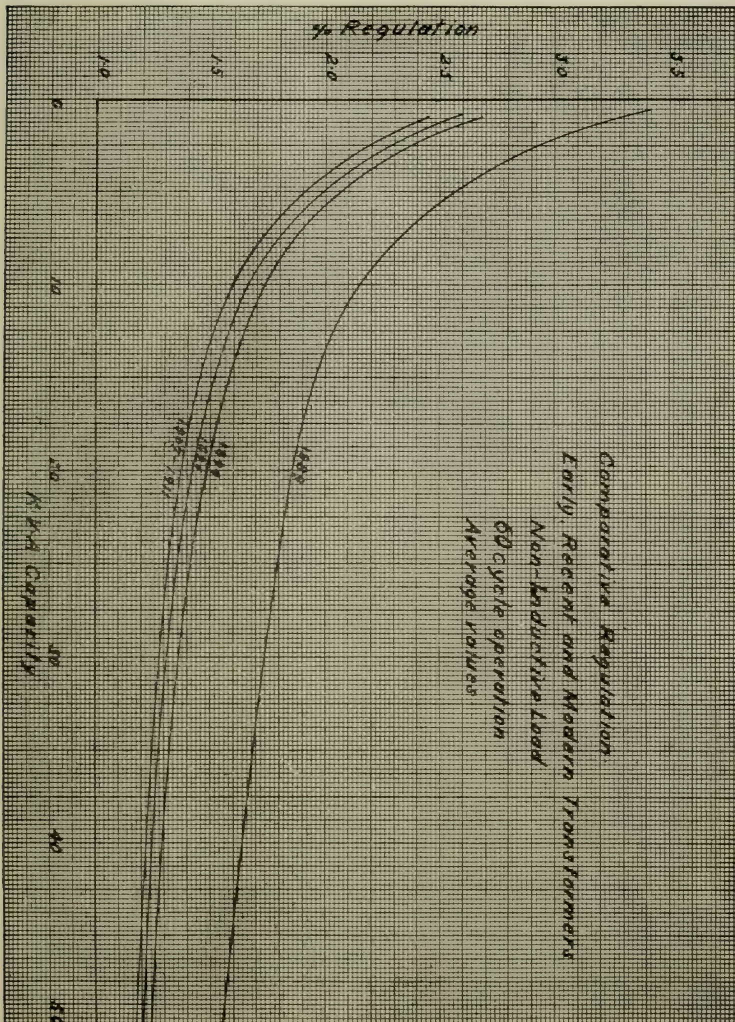


Fig. 2

copper losses in the new designs coupled with the advantage of better continuity of service. In fact, it would be economical engineering on the part of central stations to replace many of their old transformers by new and

more efficient designs. even if the old transformers are still operative Thus, the depreciation charge to be placed against a transformer does not depend upon the natural life of the apparatus, but upon the time during which it can be profitably kept in service.

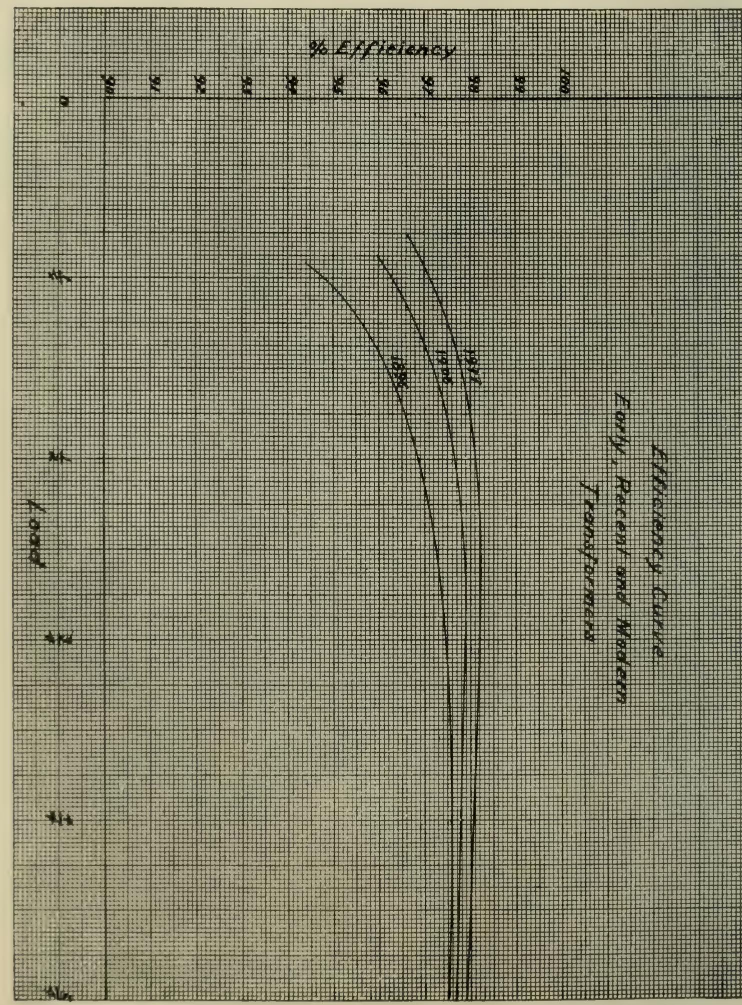


Fig. 3

Popular Sizes: It is found upon making comparisons between the size or sizes most popular a few years ago and those in greatest demand to-day, that more transformers of a larger capacity are being put in use. This is due partly to the larger number and closer proximity of services required,

and partly to the economical advantage to the central station from the fact that both the cost per unit of capacity and percentage of losses is lower in the larger sizes of transformers.

Uniformity of Product: In the most improved designs of lighting transformers, care has been exercised to obtain the highest space factor, the best method of insulating, a rugged construction and a uniformity of heating which, along with the fact that steel obtainable is practically non-ageing, insures a continuity of service and a high and constant efficiency. However, the manufacturer is interested in insuring that the quality of his apparatus is being maintained and his predeterminations being met as nearly as possible by his entire product. This can only be insured by his knowing and controlling the quality of the materials entering into the construction of his apparatus.

Although vast strides have been made in the development of alloy steel, resulting in a product of low magnetic loss, considerable difficulty has been and is being experienced in obtaining a reliable and uniform material. In order to protect themselves against this lack of uniformity, the transformer manufacturers who are anxious to insure a uniform iron loss in their distributing transformers, have installed at considerable expense, apparatus for testing each lot of iron, after which it is graded and used for the purpose for which it is best adapted.

It is also found necessary to anneal all steels, although same may have received an anneal at the mills. This removes all injurious effects of mechanical operations on the steel.

It is also found to advantage to have control over and carefully select and test the insulation entering into the transformer, such as the covering of the conductor, the insulation between layers and between sections or parts, and finally care must be exercised to insure a thorough and proper vacuum drying and compound filling treatment. This last operation is so dependent upon the proper conditions of drying, of temperature of the compound with respect to its flow point, the pressure applied for filling and the qualities of the compound itself, that the most careful supervision and regularity of testing must be exercised to insure the most desirable results.

Central Station Testing.

Necessity of Testing: If the manufacturer finds it necessary to test his raw materials in order that he may know what is entering into his product, and thus insure meeting his predetermined characteristics, it is equally important that the central station test each piece of apparatus being placed on its system. The advantages to be gained from these tests are:

First: A check is made on the manufacturer to insure his having met the guarantees under which he has sold his apparatus.

Second: A complete knowledge is obtained of each piece of apparatus composing the plant.

Third: Assurance is afforded that apparatus which it is desired to operate in parallel is suitable for such operation, with regard to ratio, polarity, and impedance.

Fourth: Any defects resulting from handling, such as improper pro-

tection against the weather or rough treatment during transportation are found out.

Thus the tests to be made and which will give a complete knowledge of the characteristics of a transformer will be:

1. Insulation Test, consisting of a test between parts and a high voltage test across the windings.
2. Measurement of Core Loss and Exciting Current.
3. Measurement of Resistance.
4. Measurement of Impedance.
5. Heat Run.
6. Ratio and Polarity Test.

Precautions in Testing: Errors in measurement resulting from unsteadiness of the voltage or current and lack of skill of the observer, may be eliminated largely by taking a number of readings and plotting the results in the form of a curve or by taking an average. Of course, inaccuracy in the instrument produces errors which are constant and which cannot be eliminated by any number of readings.

Testing of insulation is the most important of all and should be made just previous to sending a transformer out for installation. This test should be made by applying a high voltage to the insulation rather than by taking an insulation resistance, as the insulation may show a high resistance when a low voltage is applied, but be quite unable to withstand comparatively high voltages. In making the high potential test between the high voltage winding and the core or low voltage winding, the low voltage winding should be grounded in order to guard against a high voltage being induced between the secondary and core which may be sufficient to cause a breakdown of the insulation at this point. Again, during this test, all primary leads as well as all secondary leads should be connected together or the potential strain may vary throughout the winding and in fact be greater at some point than at the single terminal to which the voltage is applied. In applying a high voltage across a winding, care must be taken to avoid an excessive exciting current, by employing, if necessary, a higher frequency circuit than that on which the apparatus is to be used.

In making a core loss test, it should be remembered that the iron loss in a transformer will be affected by the wave shape of the impressed voltage, a peaked wave usually giving somewhat lower core losses than a flat wave. All guarantees should be made on a sine wave.

An error of considerable magnitude is often introduced in taking the resistance of a piece of apparatus, by using a current of such strength that the windings are heated to a sufficient degree to greatly affect the resistance. Twenty-five per cent. of the normal current is usually safe and sufficient.

In a heat test it should not be considered sufficient to ascertain the temperature of the oil or coil surfaces, as the greatest heat will be found in the interior of the winding. This can best be determined by making use of the increase in resistance method, while at the same time due consideration must be given to the arrangement of parts and facilities afforded for the dissipation of heat through oil duct, etc.

Summary and Anticipation.

It might be asked if marked improvements in losses cannot be reasonably anticipated. There cannot be any improvement in copper, and it is scarcely hoped that any very radical improvement may be found in the steel used; and with the losses at such a low level as we now find them (the efficiencies running from 97 to 98.5), no very marked increase in efficiency is anticipated. Of course, a more efficient transformer could be produced, but with an increase in materials, such that any advantage in low losses would be offset by a higher cost, since a decrease of one per cent. in core and copper losses requires over three per cent. increase in active material.

The careful selection and treatment of alloy steels, the judicious use of highly developed insulating materials and processes, coupled with the scientific proportioning of parts have produced an article more safe, more reliable, more economical and at less cost than any similar piece of apparatus placed on the market or in operation; and it is scarcely reasonable to expect that any material lowering of losses or change in design of the best class of distributing transformers now being built will warrant their replacement for some time to come.

With these conclusions before us, we recognize the most important item entering into the annual cost of operation of a transformer is its justifiable depreciation charge. Therefore, the characteristics which should receive and are receiving, by many engineers, more careful consideration, are long life with continued service. Of course, other things being equal, lower losses will still be sought for, and the future may bring forth reductions in losses due to developments in silicon steel; although, as stated above, very marked improvements are scarcely hoped for. But we venture to predict that from now on, durability will demand the careful consideration of the operator in making his comparison and selection of apparatus, and the best class of distributing transformers will be built primarily for long service.

DISCUSSION.

The President: The paper is now open for discussion.

Mr. S. B. Hood, Toronto Electric Light Company: I think the paper covers the field very thoroughly. But there is one point that has occurred to me, and I would like to ask Mr. Sisson why he does not take it up in the paper, and that is a big feature that has developed in our new common neutral ground system. Before we grounded our neutrals it was a common occurrence after a thunderstorm to wake everybody up. As we started to ground our neutrals the trouble seemed to decrease, and now as we have all circuits with common neutrals, that is, one common wire on both primary and secondary, it is an almost unheard of thing to knock out transformers. That is a thing I have not been able to find out. Invariably in a thunderstorm those transformers, if secondaries are not grounded, will go out on both sides of the primary.

Mr. H. S. Brown: One point in connection with Pole Type Transformers, which has not been brought out thus far, and in which both Central Station and manufacturer are interested, is the question of taps.

It is true that it is to some advantage, particularly at the ends of long stretches of line, to have a transformer the ratio of which may be varied by means of taps, but such cases are isolated, and it is very doubtful in my mind if the expense, both in first cost and in increased cost, due to increased depreciation, etc., is warranted in every transformer. Taps undoubtedly make it considerably harder to insulate, on account of the fact that they destroy the regular contour of the windings, this occurring at or near the end turns, where the insulation is most needed.

If taps are provided in every transformer used by Central Stations, it greatly increases the possibility of linemen making wrong connections, with disastrous results to the transformer, particularly when such transformers are operated in parallel.

I will be glad to hear if our Central Station friends consider that the few advantages of the taps offset the many disadvantages in their experience.

Mr. Pratt, Hamilton: I think Mr. Brown's suggestion in regard to transformer taps is a very practical one, and one that should be discussed by men more technical than I am. But I know that in our own Company we find it of very great assistance at times to be able to get hold of transformers with taps, with either a 10 per cent. or 5 per cent. variation either up or down. At the end of a long, heavily loaded circuit very often the only means of giving a man proper service is by means of taps. And then again sometimes we have a lighting customer in a district where we have not anything but a power circuit, he can scarcely use our service because the voltage runs up so high at night. Recently we built a line down the mountain side and we were faced with the problem of converting 3 phase current into 2. If all our transformers had been provided with Scott taps it would have been a light matter for us.

Mr. A. A. Dion: I can back up what Mr. Pratt has said in regard to the advantage of the taps, whatever the technical difficulties may be as regards insulation. Ordinarily we have not experienced any trouble, and the ability to boost the voltage has been of great assistance and in some cases has helped us out of a hole. You may not wish to boost permanently but only until you can arrange other means of improving your distribution, and it is a very useful thing to be able to use transformers with taps. Then they are also useful in many cases in connecting a 3 phase motor to 2 phase system or vice versa, and at the present time we are getting all our transformers with taps.

With regard to the grounding of the transformers, I would like to add my testimony to those who have already spoken as to the effect on the transformer when lightning comes into it. We have found certainly no increase in the damage to transformers from lightning since we are grounding everything, transformers and secondaries.

Mr. Lambe: I do not think that Mr. Brown has quite a proper appreciation of the situation when he tries to buck taps on a day like this. (Laughter.)

Mr. Brown: I am not trying to buck taps at all. I am trying to get it down to a standardization.

Mr. Lambe: Mr. President, one thing that has often occurred to me in connection with pole type transformers is that with profit to everybody, manufacturer and consumer alike, you could cut out a number of the smaller sizes. The majority of makers, I think, start around 600 or 1000 watts and go up by approximately 500 watt steps to say 3 k.w., it seems to me that both price and delivery could be improved by eliminating almost half of these smaller units, while still offering a sufficient choice of sizes.

The President: I think the manufacturers ought to get together and appoint a Committee and the Association appoint a Committee, and both meet and see just what could be done to standardize the taps as far as Canada is concerned. It is apparently necessary from the operators' point of view that they should have taps under certain conditions. Manufacturers, on the other hand, want to get away from them Apparently they have got to compromise.

If no further discussion we will proceed to the rest of the business.

We have the Report of the Commercial Committee. I believe that Committee should be continued for the ensuing year. The incoming administration will deal with that question no doubt at their next executive meeting.

Before closing, I am sure our Association owes a deep debt of gratitude for the very active way in which our members, especially the Entertainment Committee, Standing Committees and our Programme Committee have provided for this Convention. I think we can all say that due to their earnest efforts and hard work that our Convention has been the success which it has been. I do not know that a resolution is necessary. I will extend to these Committees, and also to any body or organization which have lent their assistance and co-operation or facilities in any shape or form, the most cordial appreciation of this Association. Those in favor of that feeling will express their appreciation in the usual manner by the clapping of hands.

A very hearty response by hand-clapping was given.

The President: Does any member know of any other business that should come up at this Session?

Mr. A. A. Dion: According to the Constitution the place for the next Convention should be settled by this meeting, except that it has the right to delegate this to the incoming Executive. But there should be a motion to that effect.

In accordance with the practice of the last few years I should like to move that the matter of selecting a place for the next Convention be left to the incoming Executive.

This need not prevent any member here from making suggestions or invitations if he feels like it.

The President: Have we any written invitations to go to any particular place or hold the Convention at any point? Any opinion to express as to where the Convention should be held next year?

Mr. McDougall: I second Mr. Dion's motion. (Carried.)

THE PRESIDENT: Mr. Martin will read a list of the Officers for the coming year.

President - - - -	D. R. STREET, Ottawa Electric Co., Ottawa.
1st Vice-Pres. - - -	A. L. MUDGE, Electric Power Co., Toronto.
2nd Vice-Pres. - - -	D. H. McDOUGALL, Toronto Power Co., Toronto.
3rd Vice-Pres. - - -	WILLS MACLACHLAN, Electric Power Co., Belleville.
Hon. Secretary - -	T. S. YOUNG, 220 King Street West, Toronto.
Sec'y-Treas. - - -	H. G. MARTIN, Toronto Electric Light Co., Toronto.

MANAGING COMMITTEE

1. A. A. DION, Ottawa Electric Co., Ottawa.
2. J. S. GOULD, Citizens Electric Co., Smiths Falls.
3. F. G. CLARK, Toronto Electric Light Co., Toronto.
4. L. W. PRATT, Dominion Power and Transmission Co,, Hamilton.
5. R. S. McDUNNOUGH, North Shore Power Co., Three Rivers, Quebec.
6. H. G. MATTHEWS, Quebec Railway, Light and Power Co., Quebec.
7. E. L. MILLIKEN, Cape Breton Electric Co., Sydney, C.B.
8. W. L. BIRD, Kaministiquia Power Co., Fort William.
9. A. E. DUNLOP, Pembroke Electric Co., Pembroke.
10. R. M. WILSON, Montreal Light, Heat and Power Co., Montreal.
11. R. H. SPERLING, B.C. Electric Railway, Vancouver, B.C.
12. R. J. SMITH, Canadian Electric and Water Power Co., Perth.
13. W. G. ANGUS, Dominion Power and Transmission Co., Hamilton.
14. W. S. ROBERTSON, Electric Power Co., Toronto.

THE PRESIDENT: Any other questions to come up? If there is no other business, I will declare this Session of the Canadian Electrical Association closed.

MR. D. H. McDOUGALL: Before closing, I think this Convention ought to pass a vote of thanks for the able way in which the President has presided at these meetings. (Loud applause and hand-clapping.)

THE PRESIDENT: I thank you for your vote of thanks. I appreciate deeply the honor which the Association has conferred upon me, and I would ask that you afford to the incoming administration the same amount of assistance and enthusiasm that you have in the past.

Proceedings of the Twenty-Fourth Annual Convention

of the

Canadian Electrical Association

Held at Montreal, Que.
June 24th, 25th and 26th
1914

Office of the Association
10 Adelaide Street East
Toronto, Ont.

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Canadian Electrical Association

Officers 1914-1915

President:
D. R. Street,
Ottawa Electric Co., Ottawa.

1st Vice-President:
D. H. McDougall,
Toronto Power Co., Toronto.

2nd Vice-President:
R. M. Wilson,
Montreal Light, Heat & Power Co., Montreal.

3rd Vice-President:
Wills Maclachlan,
Electric Power Co., Toronto.

Honorary Secretary:
T. S. Young,
220 King Street W., Toronto.

Secretary-Treasurer:
Alan Sullivan,
10 Adelaide Street East, Toronto.

Advisory Committee:
Composed of Past Presidents Eligible for Office.

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J. S. Norris,
Montreal Light, Heat & Power Co., Montreal.
L. W. Pratt,
Dominion Power & Transmission Co., Hamilton.
The President,
National Electric Light Association, New York.
W. S. Robertson,
Electric Power Co., Toronto.

TWENTY-FOURTH ANNUAL CONVENTION OF THE CANADIAN ELECTRICAL ASSOCIATION.

The Twenty-fourth Annual Convention of the Canadian Electrical Association was held in Montreal on June 24th, 25th and 26th. Headquarters were at the Ritz-Carlton Hotel, where special and very complete arrangements had been made by the Montreal Convention Committees and the management of the Hotel. Proceedings took place in the large ballroom, which was admirably suited for the purpose.

The attendance was very large, being over four hundred.

The various papers were of unusual excellence and the discussions that followed were general and illuminating.

The Convention was addressed by some notable visitors, and received an official welcome from the City of Montreal, through the person of Alderman Leslie Boyd.

In the way of entertainment for the Convention, numerous excursions and hospitalities had been provided. It appeared that every possible taste had been foreseen and taken care of, and the delegates to the Convention were not slow in expressing their appreciation.

There was in evidence throughout the gathering a spirit of confidence, good feeling and co-operation. It was felt that the future of the Canadian Electrical Association was secure, and that the foundation laid by the work of past years had grown into a structure that would occupy a dominating position in electrical affairs in Canada.

MEETINGS HELD AT RITZ-CARLTON HOTEL.

JUNE 24th, 25th, and 26th, 1914.

COL. D. R. STREET, PRESIDENT, IN THE CHAIR.

Wednesday, June 24th, 1914.

Meeting opened at 10 a.m.

THE PRESIDENT: Ladies and Gentlemen, I will now call the meeting to order. The first proceeding usually is the reading of the Minutes, but I have before me a resolution to be submitted, covering this point.

It is moved by Mr. Dion, seconded by Mr. Gould, that the Minutes of last year's meeting be considered as read. (Carried.)

I will ask Mr. J. S. Norris, General Manager of the Montreal Light, Heat & Power Company, to introduce the representative of the Mayor of the City of Montreal.

MR. J. S. NORRIS: Ladies and Gentlemen, in the person of Alderman Leslie Boyd, representing the City of Montreal here this morning, we not only have the leader of Council of the English section of the city, but also a distinguished personage in many other respects. Alderman Boyd is distinguished, first, perhaps, because he represents the richest and most influential ward of this city; also that he has been returned by acclamation successively to represent this ward for a number of times. That indicates his strength. He is also distinguished in the fact that he is one of our foremost and leading lawyers and King's Counsel. And, finally, if not least, he is distinguished in the sense that he had the privilege of refusing the Mayoralty nomination at our last election. There are other distinguishing features about Alderman Boyd. I do not know whether I should mention this particular one; I just only heard it in the corridor. You can draw your own conclusions. A gentleman said to a lady, "Come over here and I will introduce you to Alderman Boyd." And she said, "No; I am tired shaking hands with Leslie." (Laughter.) That would seem to me that he is distinguished amongst the ladies.

I do not think I will say anything more for fear that Alderman Boyd might, in Council, probably move to reduce electrical rates in Montreal, so I will just call upon him.

ALDERMAN L. BOYD: Mr. President, Ladies and Gentlemen, if I did not feel this morning that I was amongst so many of my own personal friends, I certainly would be highly embarrassed by the remarks of my good friend, Mr. Norris. I have heard things this morning that I never knew before.

The City of Montreal, I may say, Gentlemen, is delighted that you are holding your big Convention here, and His Worship the Mayor asked me to express to you his deep regrets that, owing to his many official duties during this busy time of the year, he would be unable to be present personally to open your Convention and extend to you a most hearty welcome during your Convention. He also asked me to convey to you the freedom of the city, and, as most of you gentlemen know, it has been a custom, not practically but theoretically, to offer the keys of the city to any delegation of importance that comes here, in order that they may use the keys, open up any of the private buildings that the city may own and investigate for themselves just what treasures the City of Montreal may have in store.

It has been particularly pleasant to me, Mr. President, Ladies and Gentlemen, to have had the privilege of coming here this morning, not only as representing the City of Montreal, but personally. I have had the honor and privilege of welcoming a great many conventions, a great many delegations to the City of Montreal, during the past two or three years, but I say, Gentlemen—and I say it feelingly—that I never felt more like extending a welcome to a delegation than I do to you members of the Canadian Electrical Association. I am glad to say that amongst your many members I number a great many of them as my own personal friends, and I almost feel that, next to being a lawyer, I should have been an electrical man, because I have been associated with so many men of your profession that I feel I am practically one of you. I had the honor of being Chairman of an Arbitration Board of a small Electrical Association in the City of Montreal, and to show how smoothly the workings of that Association went—although I believe I still am the Chairman—I have never yet been called upon to arbitrate any points.

Now, Gentlemen, I know that you have a very busy three days before you. I forgot to tell you that I am on the Reception Committee. I must admit that I have been very neglectful in my duties because I have not attended very many of their meetings, but I can see very plainly from the programme they have mapped out that there is not going to be one dull moment for you during your stay in the City of Montreal. And I am quite sure that the entertainment that these gentlemen have provided for you will send you away from the City of Montreal satisfied that we have a great city, and satisfied that they have made your stay here most enjoyable. And not only that, apart from any entertaining they may have provided for you, I feel quite satisfied that after the many conferences which you have mapped out for your programme, you will leave the City of Montreal feeling better acquainted one with the other, feeling that you know the City of Montreal and feeling also that you have mutually benefited, not only socially, but from a business point of view. And I know that when your Convention is over you will leave the City of Montreal with the kindliest feelings for those who have endeavored to entertain you, making your stay here pleasant, and you will carry away with you just one feeling, and that is, that the Canadian Electrical Association will hold its annual Convention here as soon as possible after the other cities have had their turn. I welcome you, Gentlemen, to the City of Montreal. (Applause.)

The President: On behalf of the Canadian Electrical Association, and the ladies and gentlemen present, I now thank Mr. Boyd most heartily for the warm welcome he has accorded us. One might almost forget that he is a politician from the warm manner in which he has spoken here. However, that you might not overlook the fact, you will note that we have given him a red, white and blue badge.

We feel very grateful indeed for the keys of the city which we are to receive. I know that a good many here possibly would like latchkeys as well. (Laughter.) However, we feel very grateful indeed for your kind words of welcome.

It is a pleasure to see here to-day so many ladies. I do not think very often before has our Convention been so graced in this manner. Personally I would very much prefer to see them on the main floor, because we have had great difficulty in bringing the gentlemen down, on account of the attractions in the gallery.

The next in order is the President's address, which, as a rule, is a stereotyped matter, but is upon the order paper and must be read.

PRESIDENT'S ADDRESS.

CANADIAN ELECTRICAL ASSOCIATION.

Your Worship (Mayor of Montreal), Ladies and Gentlemen, guests of the Association, and fellow-members,—I wish, on behalf of the Canadian Electrical Association, to extend to you, one and all, a hearty welcome, with the earnest hope that this gathering in the commercial metropolis of Canada may prove enjoyable to all and most instructive to those who will attend our various business meetings. The fiscal year which we are now closing has been rather hazardous for your Association. At the outset we were cruising very near the rocks, and had I, as President, and had the members of your executive, when honored by your election, realized the task before us, I doubt if a single one of us would have had the courage necessary to enter into the work.

At our first executive session we were confronted with the fact that we did not have a secretary. Mr. Young, who had so ably filled this position for many years, had resigned, for personal and other reasons. His successor had been ill for many months, and the gentleman who had kindly consented temporarily to do his work knew very little of electrical association affairs. With the demoralization of our office, we were face to face with some dissension in our ranks for various reasons. The majority strongly favored our affiliation with the N.E.L.A.; some dissented; while others felt that municipal organizations should be admitted to the Association, and that manufacturers should derive some benefits as Class A members. The fact was that the Association, while having done splendid work in a quiet way, had not kept itself before the spot-light, thus causing some of its members to ask themselves the question, "Is this Association of sufficient use to justify our giving to it the time and the trouble which we have given in the past?" You can, therefore, see that it was, indeed, an unenviable task with which your executive officers had to deal at the outset. We all realized thoroughly our responsibility, and felt that it should be our proud endeavor to maintain the old and cherished traditions of the Association, and by personal influence and activities strive to place its banner a little higher up on the flagstaff of progress, and thus secure for our Association the power for greater usefulness among its members. We felt that many of our member companies did realize and others could be quickly shown that the best things in life grow out of man's intermingling with his fellow-men; that no man can remain alone in his solitude and absorb the best attributes that emanate from the minds of other men; they could be taught to appreciate the strengthening forces for good that cluster around an organization like the Canadian Electrical Association. It was, therefore, decided to HOLD ON AND NOT TO THROW AWAY WHAT WE MIGHT NOT BE ABLE TO GET BACK.

Therefore, to get down to business, it was necessary to obtain a permanent secretary thoroughly informed and in thorough sympathy with Central Station organizations, who could approach the managers of these companies not now members and bring them to realize that, as leaders in such an industry, they should not fall short of either its opportunities or its responsibilities, and that they could not afford to stand aloof from an

Association offering protection, education, and alliance for the common good. With this end in view, Mr. J. H. Larmonth, electrical engineer, resident of Toronto, was found to be available, and was immediately engaged. The larger companies of Canada, thoroughly aware that it was now imperative that some united move be made to improve the standing of privately owned companies, particularly in Ontario, where they are in the anomalous position of being subjected to the jurisdiction of the organization with which they are in active competition, agreed to guarantee a fund, and to make one last effort to put this Association upon a sound basis. The next step was to find out our strength, numerically and financially, to ascertain the possibilities of expansion, and to formulate a plan for active work. When doing this, some very interesting statistics and astounding figures were brought to light. These will be covered by the secretary's report. It was found that, out of 510 electric power plants operating in 464 municipalities in Canada, 336 of these plants were owned by private companies and 174 by municipalities, the number of municipal plants having grown very rapidly during the last few years. The fact that only 54 out of 336 plants were, at the commencement of the year, members of our Association was an eye-opener, and it was a further eye-opener to realize that these 54 plants represented a capital investment of $110,000,000, and having 3,200 shareholders, 3,100 employees, with an aggregate pay roll of over $2,000,000.

The work of our secretary was crowned with fair success; but Mr. Larmonth, having received a tempting offer in the West, was induced to accept it, and reluctantly resigned. The Association, however, has been fortunate in securing the services of Mr. Alan Sullivan, of Toronto, an engineer of high standing and a man of literary qualifications. Mr. Sullivan's report, to be submitted later, will, I am sure, be received with much interest.

Your executive, in looking to the future, is aware that there is a wide field for hard work in the Canadian Electrical Association, and that the time is now ripe for prompt action. Some of the work cannot, by reason of its nature, be a matter for public discussion; it should be the subject of quiet but concerted action on the part of the privately-owned companies. For this reason we are calling together the presidents, directors, and larger shareholders of member companies, to point out to them the many advantages of co-operation, and to obtain from the companies represented by the gentlemen present at this meeting the nucleus of a fund to place our Association in such a sound position that it will be recognized throughout Canada as a power for good, ready at all times to extend its strong arm to assist member companies and to protect the investments of the shareholders.

As an outline of what the Association purposes doing and to be submitted to Class A members, I may quote the following:—

1st. To arrange, if possible, that the Federal and Provincial Governments shall recognize the principle of Governmental regulation, through the medium of provincial commissioners. This has been generally adopted throughout the United States, most of the States in the Union now having

commission plans and controlling thereby the operation of all public service companies. Mr. McCall, late President of the N.E.L.A., in his address at Philadelphia, states that "the activities of this commission have led to a better understanding of the relations between the public and the utility companies. The presentation to the various commissions of accurate information in regard to properties, rates, services, equipment, and all the conditions surrounding the operation of utility companies and what they are required to do to serve the public, has removed and corrected much of the misunderstanding regarding them which has existed in many quarters, and fully awakened managers of properties to a sense of their responsibility to the public."

2nd. The watching of all legislation affecting companies throughout Canada, advising promptly any or all companies affected.

3rd. The co-operation of our secretary for special work, for local publicity purposes. The advice of the solicitor of the Association, and the benefits of assistance from other member companies, with the full data they may offer.

4th. The organization of a statistical department, where information of all kinds, including comparative figures of revenues and costs, will be available for member companies.

5th. The employment of an insurance expert to supervise the insurance of member companies, giving expert advice on insurance matters and generally work with a view to the reduction of insurance rates.

These alone, without considering the advantages of our affiliation with the N.E.L.A. of the United States, are sufficient reasons why every company in Canada cannot afford to be outside of our Association.

We hope to have at this special meeting well-known Canadians—men of high standing in electrical science, men who are empire builders, from the fact that we owe largely to them the enormous electrical development in Canada at the present day—such as Mr. Holt, of the Montreal Light, Heat and Power Company; Mr. T. Ahearn, President of the Ottawa Electric Company; Mr. Fleming, President of the Toronto Electric Light Company; Mr. Hawkins, of the Dominion Power and Transmission Company. We further hope to have at this meeting Mr. Insull, of Chicago; Mr. Arthur Williams, of New York; Mr. Jos. B. McCall, of Philadelphia, late President of the N.E.L.A.; Mr. T. C. Martin, the very worthy Secretary of the N.E.L.A.; Mr. Freeman, and Mr. Kemble, of Cincinnati, men of very high standing electrically in the United States, whose names are prominently connected with the N.E.L.A. and its extraordinary development.

I have not touched on the work done in past years, and, so far, have only shown what we hope to do in the future. However, it would be unfair to the members of your executive committee did I not emphasize the fact that this year alone the Canadian Electrical Association has proved the value of its existence, and has shown clearly that the small amount paid by member companies has been well invested.

In the first place, your executive has been closely following the legislation as regards workmen's compensation recently passed by the Ontario Legislature, and have had representatives attend meetings of the Ontario

Manufacturers' Association, when this subject was discussed by them with their solicitor. With no funds of our Association available for this purpose, it was not advisable to make an exhaustive study of the situation, but we feel that the Manufacturers' Association has done everything that it was possible to do. A prominent solicitor in Toronto, who has been following the various stages of the bill in the interests of two large steam railways and two other clients, was consulted by your executive, and he advised us that no option was allowed to the electric companies in the Province of Ontario as to which of the various clauses of the Act they might elect to come under, but that was a matter that would be decided by the Commissioners who would be appointed when the bill becomes law. For this reason we are sending to all Ontario companies a copy of the Act, requesting them to make a study of the contents and decide what policy the Canadian Electrical Association members will adopt when the time comes for a hearing before the Compensation Act Commissioner. Then, again, a deputation from your executive waited upon the Ministers of the Ontario Cabinet with respect to the Corporation Tax Act of Ontario, with the result that the amount in the original bill of 1% on the net revenue was cut in half and the term, "net revenue," clearly defined. This alone amounts to a saving per annum of from $3,000 to $5,000 in perpetuity for the larger companies, and a proportionate saving according to earnings for all companies in Ontario.

I wish to draw particular attention to the two programmes which are submitted to you at this meeting—one of work and the other diversion. I must lay emphasis upon that of work, which is the main reason of our being here, with a view to mutual education towards the building up of a great industry and the perfecting of the means and methods by which humanity is being better served than ever before.

The titles of the various papers, as shown in the official programme, speak for themselves, and the names of the gentlemen presenting these papers warrant a large attendance and serious discussion. At a Convention such as this not only the presentation and acceptance of reports and papers is to be desired, but live discussions and criticism is invited and expected by the writers of the respective papers.

The programme of entertainment speaks highly for the hospitable spirit of Montrealers, and we cannot express too deeply our gratitude to Mr. Norris and the members of the general committee, including the subcommittees, who have displayed such energy and business acumen in the arrangements for this Convention, which bids fair to be the banner Convention of the Canadian Electrical Association. Those who attended the Convention of the N.E.L.A. at Philadelphia, have come home proud of their membership in this sister organization, and fully realize that, while we are endeavoring to synchronize with that great Convention, it is a difficult task with our limited membership; but we hope this year to expand largely and to continue our expansion, though it will be many years before we can hope to have a registration of practically 4,000, which was shown at Philadelphia.

While speaking of our sister organization, the time is opportune to extend a special welcome to visitors from the United States, members of our sister society. I am sure they will recognize that this Dominion is becoming a worthy neighbor of that great Republic, bound by ties of blood and by friendship and a common destiny. The nations are growing together, not politically and not territorially, but in those elements and sentiments that make countries great and nations of world influence. The first great essential, that of peace and good will, is assured, not only by gatherings such as this to-day, which play no unimportant part, but by the same good judgment shown by our people on both sides of the line in the selection of legislators and national advisers. One hundred years of peace attests to this great influence.

I cannot close without expressing gratitude for the many courtesies extended to me during my term of office and appreciation of the hard work and hearty co-operation of the three Vice-Presidents, Mr. A. L. Mudge, Mr. D. H. McDougall, and Mr. Willis McLachlan, in everything and anything that pertained to the success of our organization. The same applies to all members of your managing committee, and I can only bespeak for my successor the same hearty co-operation. I desire to thank these gentlemen who have elected me as your President for the past year for the high honor conferred upon me. I can assure you it was unexpected and quite unwarranted. However, I have, with the limited time and means at my disposal, endeavored in a humble way, with the assistance of the members of your executive, to advance the affairs of the Association, and trust that the work of this year may bear fruit in the years to come, encouraging our members to continue to master the great problems of electrical science, that humanity may benefit.

Let me say, in conclusion, that I trust you will all carry back to your own homes happy recollections of an instructive and most enjoyable Convention in the City of Montreal, feeling that a debt of gratitude is owing to our many friends in this city, leaders in the world of electricity, who, in the midst of their busy life, have found time to prove their unselfishness by inaugurating the varied programme now before us. I trust that through their efforts an enthusiasm will be engendered that may accrue to your personal benefit, and to that of our Association. (Applause.)

THE PRESIDENT: The Secretary will read his Report.

THE SECRETARY: Gentlemen, I have very little to say with regard to the Secretary-Treasurer's report, because I have only been Secretary-Treasurer for a very short time, but I have had time to begin a lot of delightful acquaintances which I hope will last for a long period. There has been much to be done in the way of correspondence, and I sincerely trust that the results of this Convention will work out some kind of organization which will put me in a position to stay with you and try to increase our membership as much as possible. I feel that that is the crux of the situation, and, if we can get the Class A members, we are all right for the rest. It appears to me also that the Canadian Association is really a body which has a strong vibrant nucleus in the form of Class A members. That

nucleus radiates out its influences through the other classes. So I would like very much to see that Class A membership enlarged as much as possible.

We have some resignations which are due largely to the fact that the Convention was held last year in a place more easily got at for the Western members than Montreal. I anticipate that after the Convention is over the new applications, which are already coming in quite fast, will make up for the resignations, and I am glad to say we have already two or three new Class A members.

With regard to any special work which your Secretary-Treasurer may be called upon to do, I would like to submit to you that I think the work of this Association may be divided into two departments. One is, the distributing and exchanging of information and most valuable statistics. The other is what you might call a psychological process, which has for its object the influencing of the minds of men.

Some years ago I became very interested in the whole electrical situation and especially in the alliance between the public and the public service corporation, and all those peculiar bonds which bind the two together. The man on the street expects a great deal and he expects it at once, and has no patience if the slightest thing goes wrong. He does not understand in any way what is involved in giving him the service, which he demands without a turn of a hair. I think that is a very interesting thing, and I think that a large future for this Association lies along the line of influencing the minds of men and creating in those minds an opinion favorable to us and favorable to our undertaking. I think this opinion is the best asset of any company, and I sincerely hope that this Convention will result in a programme being laid down and carried out which will enable me to help, so far as I can, along that special line.

I do not think there is anything special to tell you. There are some statistics here, but it is late, and they will keep and they are at your service.

THE PRESIDENT: It is moved by Mr. McDougall, seconded by Mr. Dion, that the report of the Secretary-Treasurer be adopted. (Carried.)

THE PRESIDENT: Mr. Secretary, is there any correspondence?

THE SECRETARY: There are some letters from various gentlemen, all of whom wish us all kinds of success and will be with us if they possibly can. Among these is Mr. Arthur Williams who, if he does not come, will be represented by Mr. Henderschott. He is Mr. Arthur Williams' right-hand man. Also a letter from Mr. Kerr. We also expect to have Mr. Blood, Insurance Expert of the N.E.L.A., who comes as our guest and is going to give us a talk, as far as I can make out, along the lines of co-operative insurance. This at once opens up a very large vista of insurance possibilities in connection with this Association. Assume for a moment that fifteen or twenty Class A members get together and undertake to act together in placing their insurance. Gentlemen, the possible results are very marked, and I think that Mr. Blood will probably say something along those lines. I have a letter from Mr. Parker Kemble, who says he is very sorry he is not able to get away. A letter from Mr. Holton Scott, the new President of the N.E. L.A. He says in his letter that he is very glad indeed to be represented by Mr. Martin. Also a letter from Mr. Wakeman, of the Electric Develop-

ment Society; and one from Mr. Burdett, the legal representative of the N.E.L.A., who I am sorry is too ill to be with us.

The President: I have a letter from Mr. Frederic Nicholls, who regrets his inability to be present; he fully intended coming, but has been prevented by urgency of business.

Before proceeding with the work of the day, I would like very much if we could have a few words from Mr. T. C. Martin who is with us. Mr. Martin, as you all know, is Secretary of the National Electric Light Association, and has just pulled off a most successful convention in Philadelphia; probably one of the most successful in the history of the National Electric Light Association.

Mr. Martin: Mr. President, friends of the Canadian Electrical Association, and fellow members of the N.E.L.A., I hope to have the opportunity and pleasure of speaking a little later with regard to some of the more recent work of the N.E.L.A., but the literature which was shipped to me from New York four days ago has not yet been delivered, and quite possibly may be in the toils of the Custom House. I shall be very glad when I receive it to make some specific remarks on that subject.

I have been asked by President Scott to be his official representative and to convey to you his congratulations upon the continued strength and vitality which this body shows. He regards it as a happy augury of the future of the industry in this great Dominion.

I have also been asked officially by Chairman Jones, of the Commercial Section of the N.E.L.A., to represent him, and to make some definite remarks and statements with regard to our new Salesman's Hand Book which was issued at the time of the Philadelphia Convention.

I will, if you will allow me, reserve those remarks for a little later occasion.

I have come from one Convention of Central Station men to another. We were very glad indeed to celebrate in Philadelphia during the present month our 37th Convention, and in that connection to celebrate the 30th Anniversary of the first International Electrical Congress held on this side of the Atlantic, also the first International Electrical Exhibition, 1884. One of the happiest memories for me in that connection was the fact, Sir, that before we had that great Congress in Philadelphia 30 years ago it was preceded by a meeting of the British Association in Montreal attended by some of our most distinguished Englishmen and scientists from the other side of the Atlantic, among them being the then Sir William Thomson, afterwards Lord Kelvin. It made a very pleasant bond of union at that time between electricians, electrical engineers, etc., on this side of the border and those of us on the other side. From that day to this it has seemed to me the bonds of union, friendship and closer co-operation have been knit as the years have gone by, so that to-day the industry as represented on both sides of the border gathers its strength and its brightest and best outlook from our working together. And long may that continue! (Applause.)

The President has asked me to make a statement which I think is significant. I represented the N.E.L.A. in Europe last October, on a special

mission, due to the fact that we received so many enquiries from abroad as to our membership and as to our literature and the information which we distributed among member companies; frequent reference being made to the fact that we were working hand in hand with the Canadian Electrical Association. We have to-day, indeed, largely as the result of that little mission of mine, which took in six countries in Europe—we have now some fifteen foreign companies there. It is to me a source of great pleasure to know that while I was in London I myself received the membership of the companies operating in Melbourne, Australia, and Adelaide, South Australia. I also met about a dozen of the leaders of the industry at luncheon, the leading members of what is known as the London Conference of Central Station Companies, with the result that during the Convention in Philadelphia I had the pleasure of receiving from London and handing to the President the membership of thirteen London Central Station Companies, representing all there are. (Applause.) I think I may say, Sir, that we owe that very largely to the good influence which the effect of your alliance represents. (Applause.)

The President: Mr. Martin's remarks will no doubt be received by all of us with much satisfaction. We feel that the bond of friendship which was inaugurated thirty years ago at the first Convention in Philadelphia—at least the Convention at that time in Philadelphia—has borne fruit by the bringing in of the English companies just now reported by Mr. Martin. A field for co-operative work has been opened up that assures success for the N.E.L. Association.

We will now receive the reports from the various standing committees. Report from Committee on Accounting. I suppose there will hardly be a report from that Committee.

Mr. Bowden, who has been the Chairman, has been on the sick list all the year.

Report from the Membership Committee.

Mr. T. S. Young: On behalf of the Membership Committee I might say that Mr. Bucke, who is named as Chairman of that Committee, asked me to report to you and say that he had written a letter stating that circumstances would prevent him from acting. He was not aware that he was still being retained as Chairman of the Committee until he received the Convention programme.

The President: Report of Committee on Rates and Forms of Contract is now in order. Mr. J. C. Wills of the Electric Power Company will present this report. It was considered whether it would not be wiser to hold it over until the meeting of the Class A members, but I now think it would be better if Mr. Wills would let us have his report now. If necessary we could get him to read it a second time at that meeting of Class A members.

Mr. J. C. Wills:

REPORT OF COMMITTEE ON RATES AND FORMS OF CONTRACTS, CANADIAN ELECTRICAL ASSOCIATION.

To the President and Managing Committee, Canadian Electrical Association.

Your Committee on Rates and Forms of Contracts begs to report as follows:—

At the Convention of 1912, held at Ottawa, Ont., the outgoing Committee on Rates and Forms of Contracts made the following recommendations:

1. That the lists of rates be revised and kept up-to-date. (Meaning by this, the list which was inserted at the back of the 1912 Proceedings.)

2. That drafts of a standard form of contract be made, submitted to legal authority and embodied in next year's report for discussion by members of the Association.

3. That the question of uniform standards in rates be considered, by uniform standards being meant peak load periods, methods of assessing demand, questions of allowances for lamp discounts, etc.

As these points cover the vital matters affecting rates and forms of contracts, your Committee this year decided to confine its report entirely to their discussion.

1. Revision of Lists.

Upon discussion, and at the suggestion of one of our Western members, it was decided to broaden the scope of the lists submitted in the report of 1912, and endeavor to present to the members of the Association a confidential memorandum, which should include not only the rates of member companies, but, as far as possible, the rates of municipally-owned plants. It is proposed that this memorandum will contain, besides the rates, the fundamental terms, it being the opinion of your Committee that the question of terms is sometimes of greater importance than that of price. By terms we mean:—

POWER CONTRACTS.

1. Method of determining demand.
2. Power factor required.
3. Load factor guarantee.
4. Duration of peak.
5. Minimum payment.
6. Special discounts for different hours' use.
7. Cash discounts.
8. If the use of power and power rates is allowed for lighting.

LIGHTING CONTRACTS—RESIDENCE.

We believe the terms in contracts of this type are usually the same, consisting of general conditions, with the exception of discounts for long period contracts and minimum monthly payments.

COMMERCIAL.

1. If on a demand basis, how is basis determined.

2. If on a demand basis, but demand to be taken as a portion of the connected load, what discounts are allowed, etc.

A circular letter requesting this information has been sent to all the member companies, but up to date only a small percentage have replied. Your Committee would draw the attention of the member companies to the importance of this work as a means of keeping themselves fully informed as to rates or changes of rates, and would request that schedules be sent forward as rapidly as possible. It is proposed to revise this list at stated intervals of time in an endeavor to keep the member companies fully advised.

2. Standard Form of Contract.

Your Committee has not deemed it advisable to draw up what might be called "A Standard Form of Contract." While there are a number of clauses containing ideas which might be made standard, we are of the opinion that each company usually likes to retain its own wording, in some cases having good reasons for doing so. Unless all the companies interested can be brought together and the clauses and wording thrashed out thoroughly, we feel that any attempt by this Committee to promulgate a "Standard" form would be abortive. Instead, therefore, of attempting such a task, your Committee has thought it wiser to bring together, under all the headings that are required to make a complete power or light contract, the standard clauses used by a number of large companies. These may be of assistance to member companies contemplating a revision of contract forms, and present different methods of wording. While your Committee feel that the task of making a "Standard" form of contract is a very heavy one, they are also of the opinion that this question should receive some discussion at this Convention that the next year's Committee may be guided in their work. Some few of your Committee feel that if a "Standard" form of contract has to be decided upon, it would be well to adopt that used by the H.E.P. Co., particularly for lighting. When it is remembered that the contract form is usually the first impression which the consumer obtains of the company, its adoption might remove some few points of friction. In these "Standard" clauses, we have left out those dealing with Rates and Forms of Measurements. These will be considered in the third recommendation.

RATE COMMITTEE REPORT.

In taking up the third recommendation in the report of the Rate Committee for 1912 (the question of uniform standards in rates covering peak load periods, determination of demand, etc.), we find such a variation in methods among the different companies that no method may be selected as typical of general practice. Under the heading of Power Contract Terms, elsewhere in this report, we have given the contract clauses of a number of companies showing difference in requirements. While different loads may require different methods of determining demand, the purpose in establishing basis for demand rate is the same in all cases and the same with all companies. It therefore seems that there should be a more general agreement as to the proper method or methods of determining basis for demand rates. Before discussing this question it would be well to give some study to the history of electric rates, tracing the origin and develop-

ment of the demand rate, with the theory on which it is founded and its essential purpose. We will here digress for a time, endeavoring to set forth a history of rate-making, with the intention of returning afterwards to the question of determination of basis for demand rates.

History of Electric Rates.

In the early days of the electrical industry charges were based on the number of lamps connected and on the horse-power rating of motors. This method of charging is now known as the flat rate. Experience being limited and costs uncertain, it was inevitable that rates should be fixed largely by guess, the only guide being the resultant total revenue in comparison with total expenses. Since the cost to the customer under the flat rate was the same whether he used his lamps all the time or not at all, the tendency was for him to turn on all his lamps each night and to leave them burning unnecessarily, increasing both the demand on the station and the hours it was obliged to carry heavy load. This seriously increased the investment required to provide sufficient plant capacity, and also increased running expenses since the great majority of plants generated by steam. High expenses necessitated high rates, which in turn hindered the acquirement of new business. Rates being necessarily high enough to cover cost of average hours' use of lamp, were prohibitively high for lamps only required occasionally. It was to escape from this condition that central stations sought some other method of charging.

Gas was the active competitor of electricity in the lighting field, and it was natural that a similar form of rate, based on amount consumed, should appeal to the central station as the solution of its difficulties. The first type of meter put on the market was the electrolytic. The amount of current consumed, *i.e.*, the ampere-hours, was determined by the number of grams of metal carried from the anode to the cathode in the cell of this meter. The metal plates had to be taken from the meter to the central station and weighed, the result being more or less approximate and apt to be influenced by the central station manager's idea as to what the proper charge should be. The use of this form of meter was prohibited in some countries. In spite of its inaccuracies, and the trouble and expense attaching to its use, this meter was adopted by many central stations as a relief to the conditions existing under the flat rate. About 1893 an induction type of meter was designed by O. B. Shallenberger, also measuring in ampere-hours. This meter was an improvement over the electrolytic type, though less reliable than present day types. With the introduction of these meters a new form of rate was evolved, the charge for electricity being based on the ampere-hours consumed. In many cases this rate was expressed as a charge of so much per lamp-hour, the incandescent carbon lamp being the only style in use and sizes limited. With this new form of rate the central station was able to secure many new short-hour customers whom it had previously been unable to reach. The rate also tended to shorten the hours of use of load already connected, effecting a considerable saving in costs to the central station as well as to the customer.

The introduction of the commutator type and the induction types of watt-hour meters, with mechanical improvements and reductions in price, caused rates to be based on watt-hours instead of ampere-hours, but the nature or form of the rate was not altered.

It should be noted that in the earlier days of the electrical industry lighting formed much the greater part of the business, the motor load, when existent at all, being relatively unimportant. It is only very recently that the motor load has reached such proportions as to cause the day peak to compare with the lighting peak. The earlier power rates were flat rates of so much per horse power of motor rating. It is therefore in connection with lighting that we must trace the earlier developments in rate making.

With the introduction of meters and rates based on ampere-hours, lamp-hours or watt-hours, the central station entered the field against gas for short-hour customers. In designing his new rate the central station manager had certain information to guide him: he knew what his total costs had been and the total output of his station. Dividing the former by the latter, he found his average cost per kilowatt-hour of output. When the new form of rate was put in force, however, it was soon observed that it tended to cut down consumption per customer, cutting down the revenue in the same proportion while the total station costs were reduced to a much smaller extent.

The reasons for this were first set before the electrical profession in a clear and authoritative manner by Dr. John Hopkinson in his presidential address to the Junior Engineering Society, England, in 1892. The facts had been more or less completely realized earlier, and Dr. Hopkinson had outlined his theory in 1882 or 1883 in a report to the English Edison Co. The following is a summary of Dr. Hopkinson's paper, the parts in quotation marks being direct extracts:—

"You are all of you familiar with the fact that the expenses of an undertaking may be broadly divided into two classes. On the one hand there are expenses which are quite independent of the extent to which the undertaking is used, and on the other, expenses which are absent unless the undertaking is used, and which increase in proportion to the use. For example, the charges for interest on the construction of a bridge are the same whether that bridge is used much or little or at all, and the cost of maintaining the bridge is also practically independent of its user. The same is true in a large measure of a harbor or a dock. Such undertakings lie at one extreme of the scale. It is less easy to find good examples at the present day of the other extreme, as nearly all undertakings with which engineers have to deal require the employment of some capital, and there will be a fixed charge for the use of that capital, and for maintaining against the assaults of time the things in which the capital is embodied. But we can readily see, for example in the case of a cotton mill, that if, on the one hand there are expenses of interest and dilapidation which are independent of the amount of yarn actually manufactured in a given factory, there are other expenses for material and labor, and even for actual wear of machinery, which will be very nearly proportional to the output.

"But undertakings differ from each other in another respect. In some cases, the service which the undertaking is designed to render can be performed at a time selected by the undertaker; . . . the thing can, in fact, be extensively stored and kept till it is wanted, as in the case of most manufacturers. Other services must be rendered at the moment the person served desires. . . . The line must be of a carrying capacity equal to the greatest demand. . . .

"Let us see how these considerations apply to the supply of electricity for lighting. Electrical engineers now realize that they have to provide the same plant and no more, to give a steady supply day and night, as to give a supply for one hour out of the twenty-four. They also now realize that if they are to be ready to give a supply at any moment, they must burn much coal, and pay much wages, for however short a time the supply is actually taken. Indeed the term 'load factor' proposed by Mr. Crompton is as constantly in the mouths of those who are interested in the supply of electricity as volt or ampere or horse power."

Dr. Hopkinson took as illustration a station capable of supplying 40,000 16-C.P. lamps at one time, and analyzed what the charge for running such a station would be: "First, on the hypothesis that it is always to be ready to supply the 40,000 lights at half-an-hour's notice day or night, but that the lights are hardly ever actually required; secondly, on the hypothesis that the 40,000 lights are steadily and continuously supplied day and night. These are the two extreme cases possible. In the former the load factor is nil; in the latter it is 100%. If the charge is by meter at 8d. per unit, in the former case the revenue will be nil; in the latter it will be £730,000 a year."

Dr. Hopkinson proceeded to show the investment required for each portion of the plant, totalling £145,000, and to deal with the annual charges on each, annual charges covering interest, maintenance and depreciation. The interest charges would be the same, of course, in both cases, but allowing for increased wear and repairs in the case of plant carrying steady load. Dr. Hopkinson arrived at the following summary of fixed charges:—

"Total Fixed Charges:—

	Running Light.	Fully Loaded.
Land	£ 1,000	£ 1,000
Buildings	1,500	1,500
Taxes	500	500
Boilers	2,100	2,100
Switchboard and Conductors	7,800	7,800
Engines	2,160	3,600
Dynamos	1,350	2,250
Totals	£16,410	£18,750"

Dr. Hopkinson dealt in the same way with the expenses for fuel, oil, and other stores, and wages in each of the two assumed conditions, arriving at the final summary:—

"Total Charges:—

	Running Light.	Fully Loaded.
Fixed Charges	£16,410	£18,750
Coal	6,000	30,000
Stores	600	3,000
Wages	5,000	7,500
Totals	£28,010	£59,250"

Analyzing results: "Thus the cost of merely being ready to supply 2,500 units per hour at any moment throughout the year will be £28,010, and the cost of actually supplying 2,500 units per hour for every minute in the year will be £59,250. The undertaker, therefore, who incurs the liability to supply, ought to receive £11 per annum per unit from those on whose behalf he incurs the liability, and if he receives the £11 he need not charge more than 1s. 3d. per unit for what he actually supplies to cover his expenses."

"The charge for a service rendered should bear some relation to the cost of rendering it. If it is a matter of open competition the matter will settle itself, for no one will for long be able to supply some customers at a loss, and recoup himself by exorbitant profits from others. If the matter be a case more or less of a monopoly, the adjustment is less certain. . . . The supply of electricity is not quite a monopoly; companies compete with each other, and there is always the competition with other methods of illumination. . . . It is clearly to the advantage of the undertaker to secure all those customers whom it pays best to supply, and as far as may be, to compel those who are unremunerative to adopt these other methods. THE IDEAL METHOD OF CHARGE, THEN, IS A FIXED CHARGE PER QUARTER PROPORTIONED TO THE GREATEST RATE OF SUPPLY THE CONSUMER WILL EVER TAKE, AND A CHARGE BY METER FOR THE ACTUAL CONSUMPTION. In fixing the rates of fixed charge, it must not be forgotten that it is improbable that all consumers will demand the maximum supply at the same moment, and consequently the fixed charge named might be reduced, or some profit obtained."

What Dr. Hopkinson termed the fixed charge is now generally known as the demand charge, being based on the consumer's maximum demand. The form of charge recommended by Dr. Hopkinson is known as the two-charge or Hopkinson rate.

This form of rate was first adopted by the Manchester Electric Lighting Works, designed by Dr. Hopkinson, some time previous to the reading of the above paper. It has since been widely adopted, and is perhaps the most generally used form of rate.

We have given Dr. Hopkinson's theory at some length, but it practically covers the whole theory of rates as far as at present developed.

The next important contribution to rate theory was made by Mr. Arthur Wright in a paper read before the Convention of Borough Electrical Engineers at Brighton, England, in 1896. Mr. Wright accepted Dr. Hopkinson's

classification of costs into demand and running expenses, but introduced a new form of rate to cover demand costs.

Mr. Wright made a detailed analysis of the expenses of the electrical system at Brighton, ascertaining his annual demand costs to amount to about £17.9 per kilowatt taken from the mains, and his running costs to be about ¾d. per kilowatt-hour. The maximum demand of each customer was ascertained by installing demand indicators and taking the average of the maximum monthly demands recorded during the six winter months. As the sum of these demands was larger than the simultaneous demand on the station, owing to diversity in time of demand, the cost of consumer's demands per kilowatt was taken at an amount proportionally less than the cost per kilowatt of demand on mains, making the cost per kilowatt of consumer's demand £11.8 per annum, instead of £17.9.

"As it was thought impolitic to charge consumers on the true theoretical method of so much per maximum kilowatt demanded, and so much for the running costs of the units registered by their meters, on the ground that this tariff might possibly have the effect of preventing consumers installing any other lamps than those likely to be constantly used, it was suggested that nearly as fair a charge could be made, by refusing to reduce the highest permissible price per unit consumed, until the individual consumer had paid off all his proportion of the year's standing charges."

Taking the cost of the consumer's demand as £11.8 per kilowatt per annum, Mr. Wright reduced it to an equivalent figure for cost per kilowatt per day, amounting to approximately 7¾d. per kilowatt. If the consumer used his full demand for one hour per day, and his rate were 8½d. per kilowatt-hour, it is evident that he would pay the running costs of the energy consumed (¾d. per kilowatt-hour, as noted above), and in addition 7¾d. which would cover cost of his demand. For any longer use of his load it would only be necessary to charge ¾d. per kilowatt-hour to cover running costs alone, the demand costs being already provided for out of the amount charged for the first hour's use. The correct rate for Brighton consumers, therefore, assuming each used his demand at least one hour per day, would have been 8½d. per kilowatt-hour for the first 365 hours' use during year of maximum demand, and ¾d. per kilowatt-hour for all use in excess of that amount. As the maximum rate permissible in Brighton was 7d. per kilowatt-hour, the rate actually adopted was 7d. per kilowatt-hour for the first 365 hours' use per year of maximum demand, and 3d. per kilowatt-hour for all excess use. The customer who used his demand only 365 hours during year under that modification actually paid less than cost of his load, while the long-hour customers paid more than cost. However, even if the rates of 8½d. and ¾d. had been put in force, a loss would have occurred on such short-hour customers as used less than 365 hours' use of their demand, necessitating an increase in the secondary rate to off-set such loss at the expense of the long-hour customers.

For the Wright demand rate to work out absolutely correctly, it is necessary that the primary rate be based on the minimum use that may be made of demand, instead of upon 365 hours' use per year or upon any other number of hours' use. For instance, if some customers only use their

demand 120 hours during the year, the rate should be arranged to make a sufficiently high charge for the first 120 hours' use of demand to cover the fixed demand cost, as well as running costs for the 120 hours. In practice this is not always possible, since it would entail a very high rate per kilowatt hour for the first few hours' use. The tendency has been to reduce the primary rate as much as possible, applying it to a longer use. Where the figure of 365 hours' use per year, or 30 hours' use per month, has been departed from, the figure usually chosen has been 50 hours' use per month.

The Wright demand rate has been adopted by many companies, and applied to motor loads as well as lighting, but is specially favored for commercial lighting. Instead of installing demand indicators, the demand is often estimated from connected load.

The next advance in rate theory was made in a paper read before the Convention of the N.E.L.A. in 1900 by Mr. Henry L. Doherty. Mr. Doherty was apparently not acquainted with Dr. Hopkinson's theory of costs, but arrived independently at the same classification, except that he further subdivided Dr. Hopkinson's demand costs into demand costs and consumer costs. Among the consumer costs Mr. Doherty included fixed charges on meter and separate service run to each customer, expenses reading meter, and office expenses in connection with billing and accounting. Mr. Doherty claimed that the total of these expenses was determined by the number of customers, and independent of either the demand or energy consumption. He therefore advocated a form of rate directly recognizing these three classes of costs, making three charges against each customer, the first based on his maximum demand to cover cost of plant held in readiness to meet his demand, the second based on above consumer costs and not varying in any way with load, and the third based on running costs per kilowatt-hour to cover energy taken. According to investigations of the expenses of over 100 central stations by E. S. Doane, these consumer expenses amount on the average to about 15% of the total station expenses. In the case of small consumers, with a low demand for power and limited energy consumption, the expenses of metering, billing, etc., usually form the greater part of the total costs. The importance of the consumer rate advocated by Mr. Doherty has been generally recognized, and the three-charge form of rate has been adopted by a number of companies. It has not, however, been put into practice to anything like the same extent that the theory has been accepted. This is apparently largely due to popular objection to the consumer charge.

The three papers described above, those of Dr. Hopkinson, Mr. Wright and Mr. Doherty, present what is known as the cost theory of rates, as far as that theory has yet been developed. When scientific rates are referred to, it is to forms of rates designed according to the principles laid down in above papers.

During the period that above rates were being evolved, other forms of rates were designed, though on less comprehensive theories. Recognition that the total cost of supplying large customers was less, in proportion to the size of load, than the cost for small customers, led to various systems of discounts, rebates and special rates. The block rate and the step rate

are the most noteworthy of these. Elsewhere in this report, under the heading of Light and Power Rate Forms, will be found illustrations of these types of rate. Combinations of the various simple rate forms have been made in almost every conceivable way, and special schedules arranged to meet particular cases, all according to the seeming needs of the moment rather than according to any comprehensive plan or clearly outlined theory. Even where the so-called scientific rate forms have been adopted, it has frequently been only the form, the actual rates being based on arbitrary figures rather than a careful analysis of costs.

One reason for this is that the "scientific" rates make no distinction between use off-peak and on-peak. The central station manager with a pronounced valley in his load curve—which unfortunately means nearly all of them—is inclined to regard anything he can obtain for power sold during that period, over the extra running costs, as clear gain, and accordingly he offers special rates for such customers. What is needed to complete the scientific rate is some clearly outlined method or principle by which the demand costs can be apportioned. Apportioning them equally against each customer has not proven satisfactory in all cases. Perhaps some one at this Convention will be able to solve the problem.

Another objection to the "scientific" rate is that it ascribes average cost to each consumer, as distinct from the actual increment cost. A station with a certain total expense may be charging each customer the average cost per kilowatt of his demand and per kilowatt-hour, but it might be possible to take on another customer at a slight increase in total costs amounting to much less than the average rate per kilowatt and kilowatt-hour being charged previous customers. Must the central station insist upon the same rate as paid by the other customers, probably turning away the prospective customer and losing the revenue which might have been obtained in excess of the cost of supplying him? If a customer is granted special rate, how is the central station manager to define what is increment cost, average cost and prime cost, and who is to pay the lower cost and who the higher? Even if likely to prove satisfactory to the central station, leaving each case to be decided as it may arise only brings up the question of discrimination.

The above are the chief arguments against the present forms of the so-called scientific rates. These arguments may be summed up as claiming that no rate or theory has yet been evolved that satisfactorily defines the cost of serving any particular customer or class of customers. Students of rate-making who take this point of view therefore argue that the only guide in designing rates is the value of the service to the consumer. This is the stand taken by the Rate Research Committee of the N.E.L.A. in its report at the 1914 Convention.

The Rate Research Committee believes that "there are two fundamental principles:

"First: That the rates of the company should, as a whole, produce an income sufficient to give a fair return on the investment and attract capital freely to the enterprise. The gross earnings from the sale of the product must, therefore, be sufficient to cover all the necessary expenses of

operation, including taxes, bad debts, etc., a reserve for renewals and contingencies, interest at current rates, and a reasonable profit in addition.

"Second: The Committee believes that when the rates as a whole are giving a fair return on the investment as above provided for, then the rates to separate individuals and classes which go to make up the rates as a whole, should be so adjusted as to make the total cost as low as possible, and the service rendered as great as possible, by means of the most effective utilization of the plant.

"The Committee has further come to the conclusion that these results can best be obtained by adjusting the various rates to the VALUE OF THE SERVICE rendered, giving proper consideration also to the relative costs of service, and defining value of the service rendered as the amount which the user would have to pay for the same or equivalent service under absolutely fair but not destructive competition; in other words, the amount at which the user could serve himself or provide an equivalent or substitute means of service under free but not destructive competition.

"It should be noted that when the total revenue from the rates equals the value of service as thus defined, it will not give more than a fair return on the investment, as above indicated, since if competition were absolutely free, another seller might be willing to provide equivalent service and undertake the whole business for the lesser price."

As many members present at this Convention probably are acquainted with the report of the Rate Research Committee presented at the recent Convention in Philadelphia, and other members will read it in the N.E.L.A. annual proceedings, we will not go at length into that report. It is sufficient here to say that the report deals entirely with the theory of rates, advocating value of service as the only guide, as indicated in above extract, but elaborating and explaining the theory of value. The report defends variation in rates due to low increment costs. It also justifies variations according to purpose for which energy is used, due to differences in value to buyer; variations according to time or place of delivery, due to same reason; and variations according to quantity, on same grounds.

In general the value of service theory may be summed up in the somewhat suspicious-sounding phrase, "charging what the traffic will bear," with a saving clause inserted to the effect that total profits must not exceed a fair return.

Owing to the supply of electricity being, to some extent, a monopoly, the value of service theory is as vague and hard to define in particular cases as the cost of service theory.

It is evident that proper rates must levy a charge coming somewhere above the cost to the central station of supplying service, and somewhere below the value to the buyer. Unless the value to buyer is greater than cost to station there can be no business transacted. The rate must be kept within these two limits, and therefore to disregard either cannot prove permanently satisfactory. The difficulty is to define what those limits are. In view of the small consideration given to the theory of rates, in comparison to the attention given the technical side of the industry, it is too early to say that a satisfactory solution of the problem is impossible.

The man who originates a form of rate that will protect the central station against loss through selling below cost, without turning away profitable business, will do much to promote the growth of the industry.

Leaving the discussion of rate theory, let us return to the consideration of the basis for the demand rate. According to the theory of the Hopkinson rate, and also of the Wright demand and Doherty rate, the maximum demand is taken as determining the capacity of plant, and hence as responsible for all those fixed costs on investment classified as demand costs. It is the capacity or size of plant that really regulates those costs, and in assuming demand as determining capacity we must be careful to take some form of demand that actually does so. Otherwise the demand, having little relation to size of plant required, would have little relation to the fixed costs generally known as demand cost but which might more accurately be termed capacity costs. Not all definitions of demand meet this requirement. A well-known method of fixing the basis for the demand rate is to define the maximum demand as "the greatest amount of power taken continuously for twenty consecutive minutes." Another, of similar effect, defines the maximum demand as "the load indicated by the longest ordinate that can be drawn to any horizontal chord of the load curve representing by its length of space twenty consecutive minutes." Apply such a definition to a fluctuating load, such as a compressor or hoist, varying every few minutes from 100 kilowatts to 300 kilowatts. The maximum load according to such definition would be only 100 kilowatts, yet the actual plant capacity required would be between 200 kilowatts and 300 kilowatts. This is a condition that actually occurs under a number of contracts. As the result of a number of inquiries it has been ascertained that the majority of power companies are using integrated peaks, *i.e.*, the highest average load during a certain period, and while a number define the peak as the highest load continuously carried, this definition is gradually being abandoned. Where a load fluctuates constantly between certain limits, as in the case of a compressor unloading every 3 minutes or 5 minutes, an integrated peak of even 20 minutes' duration will indicate very closely the capacity of plant required to carry the load, allowing for the usual overload capacity. Where a high peak is run up at long or irregular intervals, an integrated peak of 20 minutes will fail to indicate capacity required, and an integrated peak of 5 minutes or less may be used. On the other hand, with steady loads there is little difference between an integrated peak and a chord peak (though the former should always be used as a matter of precaution), and there is usually only a small difference between a 20-minute and a 5-minute integrated peak. However, a brief overload, within certain limits, might be carried without additional capacity, and the longer period would probably indicate more closely the actual capacity necessary. Where the form of the load curve is fixed, and known previous to the signing of the contract, a suitable peak period may be selected. In many cases of new load the nature of the curve is not known, or circumstances may alter its form. It is therefore desirable that the power company be protected against brief fluctuations that a long peak period would not cover, while on the other hand it is not desirable to unnecessarily penalize the customer with a steady

load. This Committee therefore recommends to the attention of members the form of clause adopted by a Washington company, charging on a 5-minute peak, or at the company's option, on 80% of a momentary peak; also the provision of another company, charging on a 20-minute integrated peak, or, at option, on 70% of any momentary peak.

FORMS: Lighting and power rates are appended hereto.

In conclusion, your Committee urgently request a full discussion on the points brought out and particularly the following:—

1. The desirability of a standard form of contract.
2. The proper determination of demand and duration of peak.
3. Rates for off-peak use.
4. Power factor.
5. Yearly or monthly peak.
6. Allowance for diversity factor.

Your Committee would also recommend that the incoming Committee continue the discussion of points laid down by the Committee of 1912, being guided somewhat by the discussion of this year's paper, but especially continuing the compilation of existing rates and the study of the basic conditions of rate making.

Respectfully submitted.

WM. S. ROBERTSON, *Chairman.*

POWER CONTRACT TERMS.

Power Factor.

Requirements for Power Factor as expressed in the standard contract forms of several large power companies are given below:—

(a) All motors shall be selected with reference to securing the highest feasible power factor at all loads. Minimum power factor, when operating consumer's maximum load, shall be 80% for motors up to 10 horse power and 85% above 10 horse power.

(b) The consumer agrees that it will so arrange its electrical equipment that the power factor, when the plant is operating 75% of full load or over, shall not be less than 85%, and agrees that, if the power factor on tests under the above conditions of load falls below 85%, the number of horse power to be paid for shall be increased in the proportion that 85% bears to the power factor as determined by test.

(c) The minimum power factor of motors, when operating consumer's maximum load, shall be as follows: motors not exceeding 5 horse power rated capacity, a power factor of not less than 75%; motors over 5 horse power and not exceeding 10 horse power rated capacity, a power factor of not less than 80%; motors over 10 horse power rated capacity, a power factor of not less than 85%. If the power factor should be found less than that above specified, then the power consumption shall be calculated on the basis of the minimum power factor specified.

(d) Same as (c).

(f) Rate is based on kilovolt-amperes. (This means rate is based on a standard power factor of 100%.)

(g) The lowest power factor must not be less than 70%. If the power factor is found to be lower than 85%, the basis for demand calculation is multiplied by 85 and divided by the lower power factor.

(h) Power factor required is 80%.

(i) Minimum power factor requirement is 90%.

(e) In computing the maximum power taken by the consumer under Plans D, E or F, the maximum current multiplied by the voltage multiplied by 90/100 divided by 746 shall give the number of horse power to be charged for.

Load Factor.

(b) The consumer guarantees that the load factor, that is, the ratio of the average load to the average of the four highest 15-minute peaks recorded throughout the month, shall not be less than 80%, and agrees that if the load factor for any month shall be less than 80%, that payment at meter rate for that month shall be made on 80% of the average of the said four highest 15-minute peaks.

In the event of the mills not being operated to their full capacity at any time during any calendar month, the standby charge to be paid during such period shall be the same as the average paid by the consumer for the last preceding period of three months during which the mills were operated to full capacity. This paragraph applies to standby charge only.

(f) A discount of 1% will be allowed for each percentage of load factor over 25% load factor, from 26% to 50% inclusive.

The load factor is the number of KW.H. used in any month, divided by the number of KW.H. that would have been used if the maximum demand had been used steadily throughout the month.

(Note.—The section of contract determining demand frequently includes clauses providing that the peak for any month, or bill period, shall be taken as not less than a fixed percentage of the previous highest established peak. Such clauses are not strictly load factor clauses, but serve a somewhat similar purpose. Sections (f) and the first paragraph of (b) are purely load factor clauses. See under "Determination of Demand" for illustrations of other clauses.)

Determination of Demand.

(a) If required to fix the basis of billing, the consumer hereby authorizes the corporation to install and repair maximum demand or curve-drawing meters or other measuring devices at consumer's expense, or to make tests from time to time to determine the maximum amount of power used. The consumer agrees not to make any changes in or additions to his apparatus or connected load after the same has been so determined, except with the written consent of the corporation.

(b) The maximum demand shall be taken as the maximum twenty-minute integrated demand during the month or, at the option of the company, as 70% of the maximum momentary demand.

(c) Demand rate is based on the average of the three maximum 20-minute peak loads taken during the month. Such average peak shall in no case be taken as less than 80% of the highest previous established load.

(d) The company is hereby authorized to install maximum demand meters, or other measuring devices, or to make tests from time to time to determine the maximum amount of power (momentary peaks excepted) used or required at any one time by the consumer under this contract, and such amount, once established, shall thereafter constitute the basis for billing unless and until exceeded. The consumer agrees not to make any changes in or additions to the installation after the same has been connected with the company's service except with the written consent of the company, and if, at any time, consumer makes any changes or alterations without having first obtained such consent, the company shall have the right to charge for such additional service from date of last previous reinspection or test.

(f) Duration of peak varies in accordance with conditions, terms of contract, etc., but in no case exceeds ten minutes. Customer is in no case allowed to take more than 10% above the contract amount, and such excess

is allowed only for momentary fluctuations. All contracts are based on the yearly or contract peak, except that special rate is made for strictly summer load on six-months contract.

(g) The demand on any circuit, when an indicator is installed, will be the average of the regular monthly readings of the indicator between October 1st and the following February 1st in each year. The demand so determined, beginning February 1st of each year, shall be the demand for the next twelve months, except that the demand in no case shall be less than one-third of the highest reading during the previous twelve months and in no case shall be less than one kilowatt; and provided that if any direct-connected elevator (as defined below) be installed, the demand shall not be taken at less than 10 kilowatts. A direct-connected elevator is defined as being an elevator run in guides and in which the car starts at the same time as the motor. The customer has the privilege of having the indicator cut out one night in each month, provided a 48-hour written notice is given to the company.

(h) The demand shall be determined by the indication of a standard instrument showing the highest five-minute kilowatt demand. The demand rating obtained at any reading shall be in effect for one year, unless in the meantime a higher maximum demand shall be indicated, in which case the new higher maximum demand prevails, but the new maximum demand shall not be retroactive.

If, as the work progresses, any material and permanent reduction is made in the requirements for service, customer having given to the company thirty days' previous notice in writing thereof, the company will discontinue the maximum demand then in force and substitute for it the demand indicated after such reduction is made.

(i) Demand will be determined by test of the company from time to time, taking either the maximum kilovolt-amperes that continue for at least five minutes or 80% of the instantaneous maximum kilovolt-amperes, whichever will be the greater.

(j) The demand may be determined either by mutual agreement between the customer and company, or, in the case of uncertainty or disagreement, it may be determined by an instrument to record the maximum demand for the month.

(a-2) The corporation agrees with the Commission . . . to pay for three-fourths of the power ordered from time to time by the corporation and held in reserve for it, as herein provided, whether it takes the same or not. When the greatest amount of power taken for any twenty consecutive minutes during any month shall exceed during the twenty consecutive minutes three-fourths of the amount ordered by the corporation and held in reserve, then the corporation shall pay for this greater amount during the entire month.

If the corporation, during any month, takes more than the amount of power ordered and held in reserve for it for twenty consecutive minutes, the corporation shall pay for this greater amount of power during the entire month. The taking of such excess shall thereafter constitute an obligation on the part of the corporation to pay for and on the part of the Com-

mission to hold in reserve an additional block of power in accordance with the terms and conditions of this contract.

(k) The kilowatts of service are determined by the customer, and may be increased or decreased by him within limits to be provided for in each case when the contract is made, but, after any increase has been specified by the customer, no decrease shall go into effect for twelve months thereafter; and after any decrease has been specified by the customer, no increase shall go into effect until twelve months thereafter.

Whenever the customer uses in excess of the kilowatts of service that he has specified, an excess price of 20 cents per kilowatt-hour will be charged for such excess use.

(NOTE.—The above clause applies to a Hopkinson rate with block reductions. We give the rate here to explain the nature of the above clause:—

$60.00	per year	per KW.	of service	for the first 15 KW.
36.00	"	"	"	for the next 40 KW.
30.00	"	"	"	for the next 100 KW.
15.00	"	"	"	for all excess provided customer takes high tension transmission line service, otherwise $30.00 per year per KW. for all excess.

An additional charge for all electricity consumed of—

5c.	per KW.H.	for the	first	1,500	KW.H.	per month.
3c.	"	"	next	4,000	"	"
1½c.	"	"	next	100,000	"	"
1¼c.	"	for excess use.)				

No. 1. Installation of Meters, etc., and Access.

POWER.

(a) The consumer agrees to provide convenient and safe space for the corporation's meters (for which no rental charges will be made), wires and all other appliances in said premises, and further agrees that no one who is not an agent of the corporation or otherwise lawfully entitled to do so, shall be permitted to remove, inspect or tamper with the same, and that the properly authorized agents of the corporation shall, at all reasonable hours, have free access to the said premises for the purpose of reading, examining, repairing or removing their said meters, wires and other material and appliances.

If required to fix the basis of billing, the consumer hereby authorizes the corporation to install and repair maximum demand or curve-drawing meters or other measuring devices at consumer's expense, or to make tests from time to time to determine the maximum amount of power used. The consumer agrees not to make any changes in or additions to his apparatus or connected load after the same has been so determined, except with the written consent of the corporation.

(b) The amount of power to be paid for shall be determined by measurements made with recording meters supplied by the power company and located at or near the point of delivery hereinbefore specified. Either

party shall be at liberty to install additional meters for the purpose of determining the accuracy of the record made by the meters installed by power company.

(c) When necessary to place transformer or other apparatus upon the premises of the consumer, the latter will provide for same fireproof accommodation complying with the fire underwriters' requirements.

(d) A meter or meters for measuring the current supplied shall be installed on connections provided by the consumer at a convenient and safe location, and the consumer agrees to pay rental for same at the company's regular tariff rate. When necessary to place transforming apparatus upon consumer's premises, the latter will provide for same fireproof accommodation complying with requirements of the Canadian Fire Underwriters' Association.

The company is hereby authorized to install maximum demand meters, or other measuring devices, or to make tests from time to time to determine the maximum amount of power (momentary peaks excepted) used or required at any one time by the consumer under this contract, and such amount, once established, shall thereafter constitute the basis for billing unless and until exceeded.

(e) The company's employees shall have the right to enter the said premises for any legitimate purpose connected with its service.

No. 2.—Responsibility for Damage to Meters, etc.

Power.

(a) Meters and all other appliances of the corporation in said premises shall be in the care and in the risk of the consumer, and, if destroyed or damaged by fire, or any cause whatsoever, other than ordinary wear and tear, the consumer shall pay to the corporation the value of such meters and appliances, or the cost of repairing or replacing the same.

(c) The motors, transformers, or other appliances or apparatus upon the said premises may be installed by or leased from the company, shall always remain its property, but shall be in the care and at the risk of the consumer, and, if destroyed or damaged by fire or any cause whatsoever, other than ordinary wear or tear, the consumer shall pay to the company the value of such appliances or apparatus, or the cost of repairing or replacing the same. The company is to have the right of access of appliances or apparatus at all reasonable times, for purpose of examining, testing or removing same.

(d) Meters, transformers, apparatus or other appliances of the company in said premises shall be in the care and at the risk of the consumer, and, if destroyed or damaged by fire, or any cause whatsoever, other than ordinary wear and tear, the consumer shall pay to the company the value of such meters or appliances, or the cost of repairing or replacing the same, the company having the right of access to such meters or appliances at all reasonable times for the purpose of reading, testing or removing same.

No. 3.—Duration of Agreement and How Terminated.

POWER.

(a) This agreement shall continue in force after the term herein-mentioned from year to year until terminated by a notice in writing, given by either party hereto at least one month before the end of the term or any yearly term thereafter.

(b) The power company agrees to sell and deliver to the consumer, and the consumer agrees to purchase, take and use from the power company, for a period of............years from and after............electric energy to the amount of..................horse power.

(c) When accepted, the foregoing shall constitute a contract between us, which contract shall continue in force after the expiration of the term mentioned below for a further period of one year, and so on from year to year, until either party shall have given notice in writing to the other at least one month prior to the expiration of any year of a desire to terminate same.

(d) This contract, it is mutually agreed, shall continue in force after period mentioned below from year to year until terminated by notice in writing by either party, given at least one month before the expiration of the period mentioned below or before the end of any yearly term thereafter.

(e) This application, when accepted in writing by the company's General Superintendent or authorized substitute, shall constitute a contract between the undersigned applicant (hereinafter called "the consumer") and the.........................Company (hereinafter called "the company"), which shall remain in force for the term specified herein and thereafter from year to year until cancelled by either party at the expiration of any of said periods by giving the other party notice in writing at least one month before such expiration, and the contract so constituted shall cancel all previous contracts for the service specified herein. In the event of the consumer moving to other premises, this contract shall apply to such new premises in the same manner and for the same period as for the premises specified herein.

No. 4.—Right to Cut Off Services and Remove Meter.

POWER.

(a) The consumer hereby expressly authorizes and empowers the corporation at its option to remove the meters and all other material and appliances installed at its expense and cut off the supply of electricity and terminate this agreement whenever any bills for said service are in arrears or upon violation by the consumer of any of the terms and conditions of this agreement.

(b) The power company may, on giving five days' written notice besides its other legal remedies, cut off the supply of current in the event of any amount due for power under the provisions of this contract, concerning the existence of which there is no bona fide dispute between the parties, remaining unpaid for a period of more than three months after the same shall become due, under the provisions herein contained.

If at any time during the continuance of this agreement or after the termination thereof any dispute, difference or question shall arise between the parties hereto as to the construction, meaning or effect of this agreement, or anything herein contained, or the rights or liabilities of the respective parties under this agreement or as to the performance of fulfilment of any of the terms, provisoes or conditions hereof, or otherwise in relation to the terms, then and in such case every such dispute, difference or question shall be submitted to arbitrators, one to be appointed by each of the parties and the two so appointed to select a third, the decision of the majority of such arbitrators to be binding upon both parties. In the event of the said two arbitrators failing to appoint a third within seven days such third arbitrator shall be appointed upon application of either party by the Judge of the County Court of.......... In all other respects said arbitration proceedings to be subject to the provision of "The Arbitration Act" Statutes of Ontario, 9 Edward VII, Chapter 35, or any statutory modification or reenactment thereof for the time being in force; notwithstanding any such disputes, difference or question the power company shall continue to deliver the power hereinbefore provided and the consumer shall continue to pay therefor and in all respects both parties shall continue to carry out this contract, it being the distinct agreement between the parties that there shall not be, during the period of this agreement, any stoppage or cessation in the supply of said power or in the payments therefor, but that the same shall be continued as if there were no such difference.

(c) The company reserves the right to discontinue its current without notice, or to cancel this contract, at its option, in the case the consumer is in arrears in payment or in any of the company's bills, or prevents the company from supplying current according to the provisions of the contract or in the case the consumer violated any conditions of this contract.

In case the company cancels this contract or discontinues its supply of current for any of the above causes, or is through the fault of the consumer prevented from supplying the current according to the provisions of the contract, then there shall forthwith become due and payable to the company, as stipulated, damages for each month or fraction of a month, a sum of four dollars per month for each H.P. or the equivalent thereof, covered by contract.

(e) The company reserves the right to discontinue its service or to cancel its contract with the consumer at its option in case he is in arrears in payment of any charges, or violates any of the conditions of this contract.

Should the consumer make assignment for his creditors, become bankrupt or insolvent, or have an execution levied against his property, or refuse to take and pay for all that he has contracted for with the company or for the full terms of his contract, then the full tariff of the company without rebates or discounts, and for the full period of contract, less any amounts paid on account, shall immediately become due and payable, provided always that in eliminating rebates and discounts, the company shall then not go back more than one year.

No. 5.—Fixing Point of Delivery and Responsibility for Accidents.

POWER.

(a) The consumer will provide all lines on the premises and all lines connecting premises with the point of delivery, and maintain the same in efficient condition with proper devices, the whole according to the requirements of the rules and regulations of the..........................

(b) The power to be supplied under this contract shall be delivered to the consumer at..

The power company shall not be responsible in any way for the distribution of electric energy or power beyond the point of delivery to the consumer specified herein. The power company shall in no case be liable or responsible for accident, loss or damage to person or property resulting, arising or accruing in any way from the action, effect or use of electric energy after the same shall have been delivered to the consumer.

(c) Subject to the general conditions below, your company hereinafter called "The Company" is hereby authorized and requested by the undersigned hereinafter called "The Consumer" to connect its electric system with the wiring of the consumer at a point outside the consumer's premises, and to cause electric current to be there delivered to the extent, for the period, during the hours, at the rate mentioned below, which current, it is hereby agreed, shall be used by the consumer only, upon said premises only for the operation of the motors or other apparatus for the purposes hereinafter specified.

The company shall, in the supply of electric current, make use of, or, when necessary, furnish to consumer only recognized standard transformers, meters, wires and other appliances, and shall incur no liability for damage to person or property caused in any manner whatsoever by high tension electric current, or because of its wires being connected with the consumer's premises, whether through failure of any of the said appliances or otherwise.

(e) The company shall deliver the electricity at the outer boundary of the consumer's premises, and shall not be responsible for any interruption, injury or damage due to any condition arising actually or in part from the electrical installation within the said premises.

No. 6.—Requirements Regarding Wiring and Connected Load.

POWER.

(a) The consumer will provide all lines on the premises and all lines connecting premises with the point of delivery, and maintain the same in efficient condition with proper devices, the whole according to the requirements of the rules and regulations of the...............................

All electrical and mechanical equipment used by the consumer shall be subject to the reasonable approval of the corporation, and the consumer shall so take and use the electrical energy as not to endanger the apparatus of the corporation or cause any wide or abnormal fluctuation of its line voltage.

(b) The consumer shall select and use transformers and controlling apparatus suitable for use with the electric current supplied by the power company, and all the electric apparatus of the consumer used in connection with the power supplied under this contract shall be of a first-class modern design and construction and shall be operated and maintained in an efficient manner. All the electrical apparatus installed by the consumer shall be subject to the approval of the engineers of the power company, and the power company may refuse to commence delivery under this contract as long as such approval for good cause is withheld.

(c) The consumer will provide all lines on the premises or connecting same with the point of delivery, and maintain the same with the proper protective devices, and the whole according to fire underwriters' requirements, and will also procure and furnish any permits necessary to enable the company to execute the contract.

(d) All electrical apparatus made use of by the consumer shall be of good commercial efficiency, and such as to introduce no disturbing elements into the electrical system of the company.

All wiring and other electrical equipment in the consumer's premises (except transformers and meters) shall be furnished by the consumer and shall be maintained by the consumer at all times to the exoneration of the company, in conformity with the requirements of the Canadian Fire Underwriters' Association, and the reasonable rules and regulations of the company. The consumer shall protect and indemnify the company in respect to damages to persons and property, resulting in any way from defect of electrical equipment in consumer's premises, or from any negligence on the part of the consumer.

No. 7.—Requiring Notice of Changes or Additions to Connected Load.

POWER.

(a) If required to fix the basis of billing, the consumer hereby authorizes the corporation to install and repair maximum demand or curve-drawing meters, or other measuring devices at consumer's expense, or to make tests from time to time to determine the maximum amount of power used. The consumer agrees not to make any changes in or additions to his apparatus or connected load after the same has been so determined, except with the written consent of the corporation.

(c) No new connection shall be made by which the current could be used except with the written consent of the company, and any unauthorized use or connection with the company's current, either on the company's premises or between the premises and at the point of connection, or interfere with the apparatus or appliances of the company, an additional payment of $100 at its option to an amount equal to three times the value of the current used.

(d) The consumer agrees not to make any changes in or additions to the installation after the same has been connected with the company's service, except with the written consent of the company, and if, at any time, consumer makes any changes or alterations without having first ob-

tained such consent, the company shall have the right to charge for such additional service from date of last previous re-inspection or test.

(e) He shall notify the company in writing of any changes in the electric installation on his premises or in the use thereof, which may affect the service required or the charges therefor.

No. 8.—Right to Refuse Service for Certain Loads.

POWER.

(a) All electrical and mechanical equipment used by the consumer shall be subject to the reasonable approval of the corporation, and the consumer shall so take and use the electrical energy so as not to endanger the apparatus of the corporation, or cause any wide or abnormal fluctuations of its line voltage. All motors shall be selected with reference to securing the highest feasible power factor at all loads. Minimum power factor, when operating consumer's maximum load, shall be 80% for motors up to 10 H.P. and 85% above 10 H.P.

(b) All the electrical apparatus installed by the consumer shall be subject to the approval of the engineers of the power company, and the power company may refuse to commence delivery under this contract as long as such approval for good cause is withheld.

No. 9.—Liability for Interruptions.

POWER.

(a) The corporation agrees to use reasonable diligence in providing a regular and uninterrupted supply of electricity, but does not guarantee a constant supply of electricity, and will not be liable in damages to the consumer for failure to supply electricity to said premises.

(b) It is understood that the aforesaid electric energy is to be furnished from power generated by water and is to be transmitted to the consumer over transmission lines to be built by the power company from its power house to the premises of the consumer and that interruption is liable to occur in the generation or transmission of the said electric energy. This agreement, to furnish electric energy, is therefore made expressly subject to interruption in the generation and transmission of the said electric energy by causes beyond the reasonable control of the power company, provided that, in case of such interruption in the supply of electric energy, there shall be an abatement in the payment to the power company by the consumer equal to the amount which the consumer would pay for the actual time of such interruption for the quantity by which the supply of the electric energy is diminished during the interruption, which quantity, unless otherwise determined, shall be taken to be equal to the average load from the consumer's plant while under operation during the current month. The power company shall not be further liable for any loss or damage or be subject to any claim for loss or damage with respect to such interruptions or diminutions beyond such abatement in the payment as aforesaid; provided that the power company take all reasonable precautions to guard against such interruptions or diminutions and in case of the occurrence of interrup-

tion or diminutions, make the necessary repairs with all reasonable despatch.

(c) If it become necessary for the purpose of repair or other good cause to make an interruption of service, the power company may, for the purpose of repairs or for such other good cause, from time to time after due notice given to the consumer of an intentional interruption of service, cut off and interrupt same; provided that the time of such interruptions shall be that time during 24 hours following the receipt of said notice by the consumer which will least inconvenience the majority of the power company's customers upon that section of the power company's system affected by the proposed interruption. Such interruptions shall not last for a greater length of time than two hours in any consecutive 24 hours, nor shall the total number of such intentional interruptions amount to more than three in any calendar month.

If, at any time during the continuance of this agreement, the operation of the works of either party is suspended owing to the act of the King, the King's enemies, war, rebellion, invasion, riot, explosion, accident, fire, serious epidemics, floods, freshets, tempest, or other cause of like nature beyond the control of either party, the parties whose operations are so suspended shall not be liable to the other under this agreement until the cause of such suspension has been removed and injuries to the plant of either party repaired; but there shall be a corresponding pro rata abatement of payment for power; provided that each of the parties shall take all reasonable precautions and adopt all reasonable measures and the party whose operations are interfered with shall use all reasonable diligence to remove the cause of such suspension.

(c) In case the supply of current should be interrupted or fail, whether from natural causes or accident in any way, the company shall not be liable for damages by reason of such interruptions or failure, nor be considered in default, provided it use reasonable diligence to restore such supply of current for the city or municipal lighting, or purposes affecting the general public in priority to its other customers, including the consumer. In case of defective service, notice of the fact should be sent to the company's office immediately and confirmed by letter.

(d) The company does not guarantee a constant supply of electricity, and shall not be liable for any damages to the consumer in consequence of its failure to supply electricity at any time or times.

(e) The company may discontinue the supply of electrical energy whenever, and for as long as may be reasonably necessary for the operation, maintenance and extension of its system, without incurring any liability to the consumer beyond a reduction in his account.

No. 10.—Provisions for Errors in Meter.

POWER.

(b) The meters for the measurement of the power to be supplied under this contract may at any time, upon the request of either of the parties hereto and after ten days' notice to the opposite party, be tested or calibrated by the proper official designated by the Department of Inland Revenue or

the Professor of Electrical Engineering of McGill University, or by some competent person to be named and appointed by the said Professor of Electrical Engineering. In case the said meters are found to be true and accurate within two per cent., the expense of such tests shall be borne and paid by the party giving notice; in the event of the said meters being found not accurate within the limit of two per cent. either way, they shall be forthwith repaired and made good, or new ones substituted therefor, the expense of test and repair or such new meters to be borne by the power company. The bill for power supplied during the three months preceding such test shall be corrected in the proportion of the error of the meter, provided such error exceeds the aforesaid limit of two per cent., and such correction shall be accepted by both parties to this contract as settlement in full of all claims arising out of any inaccuracy of the meters.

(d) Should any meter fail to register accurately, the company may, at its option, charge for the current supplied during the time over which such failure extends, either on the basis of the quantity of current registered during the corresponding term immediately succeeding the period of alleged inaccurate registration, or on the basis of the amount of current used during the corresponding term in the previous year, or the value of the current supplied as established by evidence.

No. 11.—Deposit Required as Security for Account.

POWER.

(a) The consumer agrees that, on request of corporation, he will deposit with the corporation the sum of............dollars to be held by corporation as a guarantee that consumer will fulfil all the terms of this agreement.

No. 12.—Limiting Consumer's Right to Resell Energy or Assign Contract.

POWER.

(b) The consumer shall not, during the term of this contract, distribute, sell or supply any electric energy or power to other parties.

(c) Subject to the general conditions below, your company, hereinafter called "the company," is hereby authorized and requested by the undersigned, hereinafter called "the consumer," to connect its electric system with the wiring of the consumer at a point outside the consumer's premises and to cause electric current to be there delivered to the extent, during the hours, at the rate, for the period mentioned below; which current, it is hereby agreed, shall be used by the consumer only, upon said premises only, and for the operation of the motors or other apparatus for the purposes hereinafter specified.

No. 13.—Agreement to be Signed by Proper Official, and Verbal Agreements Disavowed.

POWER.

(a) This agreement shall not be binding upon the corporation until accepted by it through its proper officer, and shall not be modified or

affected by any promise, agreement or representation by any agent or employee of the corporation unless incorporated in writing into this agreement before such acceptance.

(c) No representations, promises or agreements shall be binding upon the company unless same shall be incorporated in this contract in writing before same is signed and accepted.

THE FOREGOING IS SIGNED BY UNDERSIGNED AFTER READING SAME, and the company's acceptance made by making connection at the point of delivery or by writing, addressed to the undersigned and mailed.

(d) When accepted, the terms and conditions of this application shall constitute a contract between company and consumer which cannot be added to, varied or waived, either verbally or in writing, by any agent, solicitor or other person except an executive officer of the company; and no representations, promises or agreements, except as herein provided, shall be binding upon the company.

The foregoing is signed by the undersigned after reading and receiving copy of same, and is subject to the company's acceptance by letter addressed to consumer within thirty days; acceptance may also be made by making connection at the point of delivery.

No. 15.—Time and Place of Payment.

POWER.

(b) Payment of the amount due for power by the consumer shall be made monthly at the head office of the power company on the fifteenth day of the following month; such payments shall be made promptly when due and without deduction otherwise than as expressly provided for by this contract; the power company to render bills within the first seven days of the following month for the power furnished during the previous month. Interest at legal rates will be charged on all overdue accounts.

The power company may, on giving five days' written notice besides its other legal remedies, cut off the supply of current in the event of any amount due for power under the provisions of this contract, concerning the existence of which there is no bona fide dispute between the parties, remaining unpaid for a period of more than three months after the same shall have become due, under the provisions herein contained.

(c) The consumer agrees to pay for the supply of current so ordered, as required by the company from time to time, and to make such payment at the company's office within ten days from date of account rendered, at the rate hereinafter mentioned, with interest at the rate of 10 per centum per annum from the date of the accounts, if not paid for within the ten days.

(d) The consumer agrees to pay the company weekly or monthly, at the company's option, at its office and within ten days of the dates of its accounts, for all electricity supplied, at the rate and on the basis hereinafter provided, with interest at the rate of 10 per centum per annum from date of the account if not paid within ten days.

No. 16.—Agreement for Exclusive Use of Company's Service.

POWER.

(a) The consumer further agrees to (1) take from the corporation all the electrical energy required by consumer for power purposes for a term of one year from the date hereon, and to pay monthly for such energy and service in accordance with the rates on the reverse hereof under class......, (2) commence payments within one month from the date of connection.

(b) It is further agreed that the consumer shall purchase electric energy from no other company than the power company aforesaid during the life of this contract, provided that the power company will supply, upon reasonable written notice, such additional power as may be from time to time required by the consumer over and above the amount herein contracted for, and the said power shall be sold and supplied on the same terms and at the same rate as for amounts herein contracted for.

(d) Should consumer require additional service in or about the premises, at any time during the term of this contract, it is hereby agreed that he shall take such additional service from the company.

(e) Whenever the company shall find that on the consumer's premises more electricity is used than is being paid for to the company, it may charge for such excess at tariff rates, from the date of the contract or the date of the last inspection on said premises. If there is a meter, and devices are installed in such manner as not to register on said meter, the company may charge the consumer $12 for every 100 watt of capacity of such devices.

The consumer shall take, use and pay for the service specified herein for the full term specified; he shall not take this service or any part thereof from any other person, firm or company.

No. 17.—Agreement to be Binding on Assigns and Successors.

POWER.

(a) It is agreed that the signatures of the parties hereto shall be binding upon their successors or assigns, and that the vacating of the premises herein named shall not release the consumer from this agreement, except at the option and by written consent of the corporation.

(b) This agreement shall be binding upon and enure to the benefit of the respective successors and assigns of the parties hereto.

Nothing herein contained shall impose any personal liability upon any mortgagee or trustee for bond-holders or upon any bond-holder or bond-holders.

No. 18.—Notice that Agents Have No Authority to Collect.

POWER.

(c) Inspectors, agents or employees of the company are not entitled to demand or accept any compensation from the customer for the services rendered.

(d) Inspectors, agents or employees of the company are not entitled to demand or accept any compensation from consumers for services rendered, nor to do any interior wiring or other work for the consumer, nor will the company be responsible for any work so done.

TYPICAL PROVISIONS IN LIGHTING CONTRACTS.

No. 1.—Installing Meter and Right of Access.

LIGHTING.

(a) The consumer agrees to provide convenient and safe space for the corporation's meters (for which no rental charges will be made), wires and all other appliances in said premises, and further agrees that no one who is not an agent of the corporation or otherwise lawfully entitled to do so, shall be permitted to remove, inspect or tamper with the same, and that the properly authorized agents of the corporation shall, at all reasonable hours, have free access to the said premises for the purpose of reading, examining, repairing or removing their said meters, wires and other material and appliances.

(b) The consumer shall provide without rental a suitable place on said premises for the company's meter, where it may be quickly and conveniently read, and further agrees that no one, who is not an agent of the company, or otherwise lawfully entitled to do so, shall be permitted to inspect, tamper with or remove the same. The company's authorized representatives shall be allowed free access to the consumer's premises at all reasonable hours for the purpose of reading, examining, repairing or removing said meter, and ascertaining that all connections are in good order. No charge will be made for the installation of the meter, but if it is found necessary to make alterations or additions to the consumer's wiring system, in order that the connections may be properly made and the meter installed, the company will supply the material and make such alterations and additions, and the consumer hereby agrees to pay the company for such material and work immediately on receipt of bill for same.

(c) A meter or meters for measuring the current supplied shall be installed on connection provided by the consumer at a convenient location, and the consumer agrees to pay rental for same at company's regular tariff rate.

Meters or other appliances in said premises, that shall be leased from the company, shall remain its property, but shall be in the care and at the risk of the consumer, and if destroyed or damaged by fire, or any cause whatsoever, other than ordinary wear and tear, the consumer shall pay to the company the value of such meter or appliances, or the cost of repairing or replacing the same. The company is to have the right of access to meters at all reasonable times for the purpose of reading, testing or removing same.

The consumer is strictly forbidden to interfere with the meters or with appliances of the company. In case of defective service, notice of the fact should be sent to the company's office immediately.

(d) The meters or other appliances of the company in said premises shall be in the care and at the risk of the consumer, and if destroyed or damaged by fire, or any cause whatsoever other than ordinary wear and tear, the consumer shall pay to the company the value of such meters or appliances, or the cost of repairing or replacing the same, the company having the right of access to such meters or appliances at all reasonable times for the purpose of reading, testing or removing the same.

No. 2.—Responsibility for Damage to Meter.

LIGHTING.

(a) Meters and all other appliances of the corporation in said premises shall be in the care and at the risk of the consumer, and if destroyed or damaged by fire, or any cause whatsoever other than ordinary wear and tear, the consumer shall pay to the corporation the value of such meters and appliances, or the cost of repairing or replacing the same.

(b) Meters and all other appliances of the company on the said premises shall be in the care and at the risk of the consumer, and if destroyed or damaged by fire, or any cause whatsoever other than ordinary wear and tear, the consumer shall pay to the company the value of such meters and appliances, or the cost of repairing or replacing same.

(c) Meters or other appliances in said premises, that may be leased from the company, shall remain its property, but shall be in the care and at the risk of the consumer, and if destroyed or damaged by fire, or any cause whatsoever other than ordinary wear and tear, the consumer shall pay to the company the value of such meter or appliances, or the cost of repairing or replacing the same. The company is to have the right of access to meters at all reasonable times for the purpose of reading, testing or removing same.

No. 3.—Duration of Agreement, and How Terminated.

LIGHTING.

(a) This agreement shall continue in force after the term herein mentioned from year to year until terminated by a notice in writing, given by either party hereto at least one month before the end of the term or any yearly term thereafter.

(b) The consumer agrees to take electrical energy for a term of...... ....from date, and thereafter from year to year until this contract is cancelled by notice in writing given by either party thirty days before the expiration of this contract or of any full year thereafter, or as hereinafter provided.

The company agrees to allow the consumer to cancel this contract at any time by giving the company thirty days' notice in writing, providing any of the following events come to pass:—

(1) Should the consumer leave said premises, and sign a similar contract with the company for the supply of all electrical energy for his new premises.

(2) Should the consumer leave the municipality or cease to reside there.

(d) This contract, it is mutually agreed, shall continue in force after period mentioned below from year to year until terminated by notice in writing by either party, given at least one month before the expiration of the period mentioned below or before the end of any yearly term thereafter.

In the event of consumer moving to a location not on company's lines, this contract will be cancelled, otherwise this contract is transferable to new location.

It is understood that in the event of the company being compelled by the corporation of .... or otherwise to adopt an underground or a more expensive system of distribution than at present employed, this contract may be cancelled by the company giving six months' notice in writing to that effect to the consumer.

No. 4.—Right to Cut Off Service and Remove Meter.

Lighting.

(a) The consumer hereby expressly authorizes and empowers the corporation at its option to remove the meters and all other material and appliances installed at its expense and cut off the supply of electricity and terminate this agreement whenever any bills for said service are in arrears or upon violation by the consumer of any of the terms and conditions of this agreement.

(b) The consumer hereby expressly authorizes and empowers the company, at the company's option, to remove at the consumer's expense the meters and all other material and appliances installed, and cut off the supply of electrical energy, and terminate this agreement, for any of the following reasons:—

(1) For non-payment of bill when due (after at least three days' notice).

(2) Assignment or insolvency of consumer.

(3) Fraudulent representation in regard to the electrical energy used.

(4) Violation by the consumer of any of the terms and conditions of this contract.

(c) The company reserves the right to discontinue its current without notice, or to cancel this contract, at its option, in case the consumer is in arrears in payment of any of the company's bills, or prevents the company from supplying current according to the provisions of this contract, or in case the consumer violates any condition of this contract whatsoever.

In case the company cancels this contract or discontinues its supply of current for any of the above causes, or is through the fault of the consumer prevented from supplying current according to the provisions of this contract, then there shall forthwith become due and payable to the company as stipulated damages, the sum of seventy-five cents per month for each sixteen candle power lamp, or the equivalent thereof, covered by this contract, for each month or fraction of a month of the unexpired term of this contract.

No. 5.—Fixing Point of Delivery and Responsibility for Accidents.

LIGHTING.

(a) The consumer will provide all lines on the premises and all lines connecting premises with the point of delivery, and maintain the same in efficient condition with proper devices, the whole according to the requirements of the Rules and Regulations of the........................

(b) The consumer acknowledges that the company does not own any wires, wiring, fittings or apparatus upon the consumer's premises save and except said electric meter and..................................

....

and that the company is not responsible for any wires, wiring, fittings or apparatus upon consumer's premises.

The company shall not be responsible in any way for the distribution of electrical energy beyond the point of connection of the company's distribution system to the consumer's wiring system on the outside of his premises, and the company shall in no case be liable or responsible for accident, loss or damage to person or property, resulting, arising or accruing in any way from the action, effect or use of electrical energy beyond the above point. The company agrees to use reasonable diligence in providing a regular and uninterrupted supply of electrical energy, but does not guarantee a constant supply of electrical energy, and will not be liable for damages to the consumer for failure to supply electrical energy to said premises.

(c) The consumer will provide all lines on the premises or connecting same with the point of delivery, and maintain the same in efficient condition with proper protective devices, the whole according to fire underwriters' requirements.

The company shall, in the supply of electric current, make use of, or, when necessary, furnish to the consumer only recognized standard transformers, meters, wires and other appliances and shall incur no liability for damage to person or property caused in any manner whatsoever by high tension electric current, or because of its wires being connected to the consumer's premises, whether through failure of any of the said appliances or otherwise.

(d) Subject to the terms and conditions of this application, the subscriber, hereinafter called the "consumer," requests the .... company, its successors and assigns, hereinafter called the "company," to connect its electric system with consumer's wiring at a point outside the latter's premises, as defined below, or such other premises on the company's system supplying similar service to which the consumer may from time to time remove, and to there furnish electricity for consumer's use only during period mentioned or any renewal or continuation thereof as provided, and for the number of lamps or other apparatus noted below.

No. 6.—Requirements Regarding Wiring and Apparatus.

LIGHTING.

(a) The consumer will provide all lines on the premises and all lines connecting premises with the point of delivery, and maintain the same in

efficient condition with proper devices, the whole according to the requirements of the Rules and Regulations of the..............................

(b) This contract to furnish electrical energy shall not be binding on the company until such time as the consumer's wires, wiring, fittings, apparatus, etc., shall have been approved by the company's inspector, and any other inspector who may be appointed under the.................... Act, or if such last inspector is not appointed, the authorized inspector of the Canadian Fire Underwriters' Association. The consumer agrees that if any alteration or addition to the installation is made on the consumer's premises, the consumer will notify the company of same before it is connected to the company's service, and secure approval, as above set forth. The company reserves the right to refuse current for any purpose which might, in the company's opinion, reduce the efficiency or the reliability of the company's service.

(c) The consumer will provide all lines on the premises or connecting same with the point of delivery, and maintain the same in efficient condition with proper protective devices, the whole according to fire underwriters' requirements.

(d) All wiring and electrical equipment in consumer's premises (except meters) shall be furnished by the consumer and shall be maintained by the consumer at all times, to the exoneration of the company, in conformity with the requirements of the Canadian Fire Underwriters' Association and the reasonable rules and regulations of the company. The consumer shall protect and indemnify the company in respect to damages to persons and property resulting in any way from defective electrical equipment in consumer's premises, or from any negligence on the part of the consumer.

No. 7.—Requiring Notice of Changes or Additions to Load Connected.

LIGHTING.

(c) No new connection shall be made by which the current could be used except with the written consent of the company; and any unauthorized use of or connection with the company's current, either on the consumer's premises, or between the premises and the point of connection, or hindrance to access to the consumer's premises, shall entitle the company to an additional payment of one hundred dollars or at its option to an amount equal to three times the value of the current used.

(d) The consumer agrees not to make any changes in or additions to installation after the same has been connected with the company's service, and that during the continuance of this contract no system of electricity or lighting, other than that furnished by the company, shall be used in said premises, except with the written consent of the company.

No. 8.—Right to Refuse Service for Certain Loads.

LIGHTING.

(b) The company reserves the right to refuse current for any purpose which might, in the company's opinion, reduce the efficiency or the reliability of the company's service.

No. 9.—Non-liability for Interruptions to Service.

LIGHTING.

(a) The corporation agrees to use reasonable diligence in providing a regular and uninterrupted supply of electricity, but does not guarantee a constant supply of electricity, and will not be liable in damages to the consumer for failure to supply electricity to said premises.

(b) The company shall not be responsible in any way for the distribution of electrical energy beyond the point of connection of the company's distribution system to the consumer's wiring system on the outside of his premises, and the company shall in no case be liable or responsible for accident, loss or damage to person or property, resulting, arising or accruing in any way from the action, effect or use of electrical energy beyond the above point. The company agrees to use reasonable diligence in providing a regular and uninterrupted supply of electrical energy, but does not guarantee a constant supply of electrical energy, and will not be liable for damages to the consumer for failure to supply electrical energy to said premises.

(c) In case the supply of current should be interrupted or fail, whether from natural causes or accident in any way, the company shall not be liable for damages by reason of such interruption or failure, nor be considered in default, provided it use reasonable diligence to restore such supply.

The right is expressly reserved to the company to supply current for town or municipal lighting, traction or purposes affecting the general public before supplying the consumer.

(d) The company does not guarantee a constant supply of electricity, and shall not be liable for any damages to the consumer in consequence of its failure to supply electricity at any time or times.

No. 10.—Provision for Errors in Meter.

LIGHTING.

(b) All meters installed by the company are first tested, certified correct and sealed by the Department of Inland Revenue of the Dominion of Canada. If the accuracy of a meter is questioned by the consumer or the company, either may proceed under the provisions of the "Electricity Inspection Act, 6-7 Edw. VII., Chapter 14," to have the meter officially re-tested. The company will undertake to remove the meter for re-test, and provide the facilities for carrying out the re-test upon the receipt of a deposit of $1.50 from the consumer to cover incidental expenses, which deposit will be returned if the meter is found to be inaccurate to a greater extent than allowed by the said "Electricity Inspection Act."

(c) Should any meter fail to register accurately, the company may at its option charge for the current supplied during the time over which such failure extends, either on the basis of the amount per lamp charged during the corresponding term immediately PRECEDING the period of alleged inaccurate registration, or on the basis of the amount of current used during the corresponding term in the previous year, or the value of the current supplied as established by evidence.

(d) Should any meter fail to register accurately, the company may at its option charge for the current supplied during the time over which such failure extends, either on the basis of the amount per lamp charged during the corresponding term immediately SUCCEEDING the period of alleged inaccurate registration, or on the basis of the amount of current used during the corresponding term in the previous year, or the value of the current supplied as established by evidence.

No. 11.—Deposit Required as Security for Account.

LIGHTING.

(a) The consumer agrees that on request of corporation, he will deposit with the corporation the sum of ....dollars to be held by corporation as a guarantee that consumer will fulfil all the terms of this agreement.

(b) The consumer agrees that upon request of the company the consumer will deposit with the company at time of signing this agreement the sum of ....dollars to be held by the company as a guarantee that the consumer will fulfil all the terms of this contract. Receipt of a deposit of......................dollars is hereby acknowledged by the company.

No. 12.—Limiting Consumer's Right to Resell Energy or Assign Contract.

LIGHTING.

(b) The consumer shall not, during the term of this contract, sell or supply any electrical energy to other parties, or sell, or assign this contract.

(c) Subject to the general conditions mentioned below, your company, hereinafter called "the company," is hereby authorized and requested by the undersigned, hereinafter called "the consumer," to connect its electric system with the wiring of the consumer at a point outside the consumer's premises, and to cause electric current to be there delivered for the number of lamps or other apparatus, during the period and at the rate mentioned below, which current, it is hereby agreed, shall be used by the consumer only, upon said premises only and for the purposes hereinafter specified only.

No. 13.—Disavowing Verbal Agreements, and Requiring Agreement to be Signed by Proper Official.

LIGHTING.

(a) This agreement shall not be binding upon the corporation until accepted by it through its proper officer, and shall not be modified or affected by any promise, agreement or representation by any agent or employee of the corporation unless incorporated in writing into this agreement before such acceptance.

(b) This contract shall not be binding on the company until accepted by the company's proper officer, and shall not be modified or altered in any way, by any promise, agreement or representation by any agent or employee of the company, unless incorporated in writing into this contract before such acceptance.

(c) No representations, promises or agreements shall be binding upon the company unless the same shall be incorporated in this contract in writing before the same is signed and accepted.

(d) When accepted the terms and conditions of this application shall constitute a contract between company and consumer which cannot be added to, varied or waived, either verbally or in writing, by any agent, solicitor or other person except an executive officer of the company; and no representations, promises or agreements, except as herein provided, shall be binding upon the company.

The foregoing is signed by the undersigned after reading and receiving copy of same, and is subject to the company's acceptance by letter, addressed to consumer within thirty days; acceptance may also be made by making connection at the point of delivery.

No. 14.—When Account is to be Rendered.

LIGHTING.

(a) In case of non-receipt of bill, the evidence of the company as to whether or not the bill was posted or delivered shall be taken as final and binding by the consumer.

No. 15.—Time and Place in Which Payment is to be Made.

LIGHTING.

(a) The consumer further agrees to (1) take from the corporation all the electrical energy required by the consumer for lighting the above premises for a term of one year from date hereof, and to pay monthly for such energy and service in accordance with rates on reverse hereof under Class .... (2) To commence payments within one month from the date of connection.

(b) The consumer agrees to pay the company for all electrical energy supplied, as shown by the meter on the consumer's premises at the rate or rates set forth in Clause No. 2. Bills will be rendered by the company at or about the end of each month, and will become DUE AND PAYABLE at the office of the company, or at such place as the company may designate from time to time, ten days from the date on the face of the bills. In case of assignment or insolvency the consumer's account to date shall become due and payable. The company agrees to allow the consumer a discount of ...... % on monthly bills, which are paid on or before due date, but no discount will be allowed when the consumer is in arrears, even if the monthly bill in question is presented for payment on or before the due date. The consumer agrees that the minimum amount to be paid under this contract shall be.................., in consideration of the company being prepared to supply electrical energy when and as required by this contract.

(c) The consumer agrees to pay for the supply of current so ordered as required by the company from time to time, according to the amount of current used, and to make such payment at the company's office within ten days from the date of the account, and at the rate and on the basis hereinafter mentioned, with interest at the rate of ten per centum per annum from the date of the account, if not paid within ten days, and subject to the rebate hereinafter mentioned if so paid within the said ten days from date of account.

(d) The consumer agrees to pay the company weekly or monthly (at the company's option) and at its office within ten days of the dates of its

accounts for all electricity consumed (as measured by meter to be installed by the company in consumer's premises), and at the rate, on the basis and subject to the rebates hereinafter provided if accounts are paid within ten days of their dates.

No. 16.—Agreement for Exclusive Use of Company's Service.

LIGHTING.

(a) The consumer further agrees to (1) take from the corporation ALL the electrical energy required by consumer for lighting the above premises for a term of one year from date hereof, and to pay monthly for such energy and service in accordance with rates on the reverse hereof under Class......

(d) The consumer agrees not to make any changes in or additions to installation after the same has been connected with the company's service, and that during the continuance of this contract no system of electricity or lighting, other than that furnished by the company, shall be used in said premises, except with the written consent of the company; and if at any time, during the term of this contract, the consumer requires additional service in or about the premises, it is hereby agreed that the consumer shall take such additional service from the company.

No. 17.—Terms for Lamp Renewals.

LIGHTING.

(c) Burnt out lamps renewed free of charge of 8-16-32 C.P. carbon filament, if not mechanically broken and if accounts are paid by the 10th of each month.

(d) Upon application the company shall supply free of charge standard (1908) clear glass carbon filament incandescent lamps of 8 and 16 candle power, of its standard base, to replace exhausted lamps; all other lamps and lamps mechanically broken shall be furnished by and at the expense of the consumer.

No. 18.—Notice that Agents or Employees are not Authorized to Collect.

LIGHTING.

(c) Inspectors, agents or employees of the company are not entitled to demand or accept any compensation from customers for services rendered.

(d) Inspectors, agents or employees of the company are not entitled to demand or accept any compensation from consumers for services rendered, nor to do any interior wiring or other work for the consumer, nor will the company be responsible for any work so done.

No. 19.—Notice re Voltage of Supply.

(b) The consumer accepts notice that the company will supply electrical energy of the following characteristics:—

............phase, alternating at a frequency of......cycles per second, and a potential of about..........volts.

(e) The undersigned applicant hereby accepts notice in accordance with Edward VII., 6-7, Chapter 14, Section 4, that the company proposes to supply electrical energy at the electrical terminals of the consumer for lighting at..........or..........volts as may be required.

FORMS OF POWER RATES.

(For definitions see under "Lighting Rates.")

Straight Line Meter Rate.

Not used except for very small motors.

Meter Block Rate.

Used to a considerable extent, more particularly for medium and small size motors. By making the blocks sufficiently large the small motor is automatically charged at a higher rate, only the large motors using sufficient energy to secure the lowest rates. This form of rate affords a convenient means of distinguishing between the cost of supplying large and small consumers.

Inasmuch as this rate fails to distinguish between the motor making a large demand for a short period, and the motor making a smaller demand for a longer period, it is usually accompanied by a demand charge in the case of large motors.

Meter Step Rate.

The same remarks apply to the step rate as to the block rate. The anomaly of a lower total charge for an increased consumption, mentioned in connection with this form of rate for lighting, exists in the same way when this rate is used for power loads.

Controlled Flat Rate.

Not used for motors.

Flat Rate.

Rates of so much per horse-power, based on the rated capacity of motors connected, have been widely used. They are still generally used for motors under 20 H.P., but for larger motors the tendency is to use some type of demand indicator, with a watt-hour meter where any form of two-charge or three-charge rate is used.

Many of the large companies and commissions, notably the Wisconsin Railroad Commission, have adopted the plan of basing the demand rate, or "flat" rate, on percentages of the rated capacity of motor, the percentage decreasing as the connected motor rating increases, the percentage varying from 85% or 90% of rating for motors of 10 H.P. to 50% of rating for motors of over 60 H.P.

There seems no justification of this method except that it affords a convenient means of reducing charge against large loads without appearing to distinguish in the rate offered. Unless accompanied by a published schedule showing percentage considered as active for each size of motor, it is apt to

prove a source of discrimination and rate-cutting. Though a fact often overlooked in quoting rates, in effect it is the same thing whether a rate is cut 50% or the basis on which rate is assessed is reduced 50%.

The remarks concerning advantages and disadvantages of straight demand rate apply equally to flat rate for motors.

Straight Demand Rate.

This form of rate is practically the same as the flat rate, except that the rate is based upon the maximum load as recorded by some type of demand indicator, instead of upon the rated capacity of the motors. It differs on one point of some importance to the power company. If accounts are made out on a monthly basis, during dull seasons the consumer may make a smaller demand at a time when his reduced demand is of no advantage to the power company. In such a case the revenue of the company suffers, without a proportionate reduction in costs, unless the contract contains some provision for charging on the highest previous peak. See under Power Contract Terms, Determination of Demand, for examples of such clauses.

The advantage of this rate is that it encourages the long-hour consumer.

Its disadvantage is that if made high enough to cover long-hour use it is prohibitively high to the short-hour user, although the possibility of selling the same plant capacity to several short-hour customers may make the latter profitable at a lower rate.

For the reasons mentioned in preceding paragraph the demand rate in its simple form is not extensively used. It is more generally used in conjunction with an energy charge.

Demand Block Rate.

The block principle is frequently applied to demand rates in the same way as to meter rates. Its purpose is the same in both cases—to reduce the charge per unit for large loads in recognition of the reduced cost per unit.

Illustration:—

Rate = \$28.00 per year for each horse-power of demand for the first 10 H.P.
18.00 " " " " " next 90 H.P.
9.00 " " " in excess of 100 H.P.

Charge for 150 H.P. maximum demand =
10 H.P. × \$28.00 = \$ 280.00
90 H.P. × 18.00 = 1620.00
50 H.P. × 9.00 = 450.00

Total charge = \$2350.00

Demand Step Rate.

The step principle is also applied to the demand rate in the same way as to the meter rate. The object is the same as in the case of the block rate noted above. The defect of the step form of rate has already been pointed out.

Illustration:

Rate = \$28.00 per H.P. per year for all less than 10 H.P.
20.00 " " " " for 10 H.P. or more.
15.00 " " " " for 90 H.P. or more.

Charge for 150 H.P. maximum demand = 150 H.P. × \$15.00 = \$2,250.00.

Hopkinson, or Two Charge Rate.

The demand charge with this form of rate is usually based on motor rating for motors of 20 H.P. or less, while for large motors it is based on peaks recorded by graphic watt-meters or other demand indicators. A watthour meter is installed in all cases.

In its simplest form this rate consists of two straight line charges: (a) a demand charge of so much per H.P. of demand and (b) a meter or energy charge of so much per KW.H.

Illustration: The consumer agrees to pay a demand charge of \$12.00 per H.P. per year, and in addition thereto 3 cents per KW.H. for energy utilized.

Consumer's demand during month (assuming bills to be rendered on a monthly basis) has been 50 H.P. and energy consumed 2,000 KW.H. Charge for month =

50 H.P.	× \$12.00	=	\$50.00
2,000 KW.H.	× 3 cents	=	60.00
	Total..........	=	\$110.00

The block principle may be applied to either one or both of the charges under this rate, and the same is true of the step principle.

Illustration: The following is the schedule of an Illinois company applying the block principle to both charges:—

\$27.00 per year per kilowatt for the first 200 kilowatts of maximum demand.

\$21.00 per year per kilowatt for any excess of maximum demand.

And an additional charge for all electricity consumed of—

5 cents per KW.H. for the first 1,000 KW.H. per month.
3 " " " next 4,000 KW.H. per month.
1.3 " " " next 25,000 KW.H. per month.
1.1 " " " next 70,000 KW.H. per month.
.9 " " for any excess use.

The following is the schedule of a Rhode Island company giving a Hopkinson rate with step discounts applying to both demand and energy

charges. This schedule only applies to customers with a demand of 5 H.P. or over, signing an annual contract:

		Monthly Service Charge	Plus Current Charge
For a demand of	5 to 10 H.P.	$1.50 per H.P.	$.015 per KW.H.
	10 to 20	1.40	.014
	20 to 30	1.35	.013
	30 to 40	1.30	.012
	40 to 50	1.25	.011
	50 to 75	1.20	.010
	75 and over	1.15	.009

By making the demand rate high and the energy rate low, the Hopkinson rate may be made to approximate a simple demand rate, while by reversing the process it may be made to approach a simple meter rate. This form of rate is very elastic, and by varying the ratio between the demand and energy rates, and by the use of the block principle, or of the Wright demand principle applied to the energy charge, a Hopkinson rate may be devised to follow almost any desired cost or revenue curve. Probably owing to its adaptability in this respect, as well as to the theory of costs on which it was founded, it is largely used and is being adopted by an ever increasing number of companies.

Wright Demand Rate.

This rate was originally designed to achieve the same results as the Hopkinson rate by an indirect method, and was designed particularly for lighting loads. In the case of power customers there is not the same objection to an open and visible charge based on demand. For this reason the Wright demand rate, though used by a number of companies, has not been as widely adopted for motor loads as for lighting.

The description of this rate given under Lighting applies to it when used for power.

As originated and adopted in Brighton, England, the Wright demand rate consisted of but two rates, the first and higher rate per KW.H. applying to the first 30 hours' use per month of maximum demand, the second and lower rate applying to all used in excess. As adopted by many companies, particularly for power, several successive reductions in rate are made for long use of demand.

The schedule of an Oregon company for general power service is as follows:

7 cents per KW.H. for first 28.8 hours' use per month of maximum demand.

5 cents per KW.H. for next 28.8 hours' use per month of maximum demand.

2 cents per KW.H. for any excess use.

In one or two instances the wording of this rate has been changed to express length of use of demand in the form of a percentage, instead of so many hours' use per month. An illustration would be:—

10c. per KW.H. for the first 5% of monthly maximum consumption.

6c. per KW.H. for the next 5% of monthly maximum consumption.

4c. per KW.H. for all used in excess.

In a month of 30 days 5% of maximum possible consumption would be equivalent to 36 hours' use of maximum demand, and in a month of 31 days to 37.2 hours' use of maximum demand, averaging 36.5 hours per month. Owing to this variation the percentage form is not as simple for calculation of bills as is the stated number of hours. The result is, of course, the same. The Rate Research Committee disapproved of the percentage form of expressing the Wright demand rate, on the grounds that it is "for the best interest of Central Stations that they should adhere to the usual methods of expressing standard rate forms."

The energy charge of the Hopkinson rate is frequently put in the form of the Wright demand rate. The following is an example of such a rate:—

Service Charge = $1.00 per month per H.P. of connected load or maximum demand, plus

Consumption Charge = Up to the first 50 hours' monthly use of load........................3c. per KW.H.
Additional consumption up to the second 50 hours' use................2c. per KW.H.
Remaining consumption..........¼c. per KW.H.

The advantage of the Wright demand rate is that it automatically takes into consideration the maximum demand as well as the energy consumed, a feature of no other form of meter rate.

The disadvantage of this rate is that if a customer uses his demand less than the amount of use for which the rate was designed, the charge made by the rate will be insufficient to cover cost of his demand.

Doherty, or Three-Charge, Rate.

Under "Forms of Lighting Rates" the definition of the Rate Research Committee for this form of rate was given.

The distinguishing feature of this rate is the customer charge. The demand charge and the energy charge are the same as in the Hopkinson rate, and remarks under that rate apply also to this.

The customer charge is designed to cover fixed costs, such as interest, maintenance and depreciation on meter and service, expenses reading meter, and office expenses for billing and collecting. These costs are fixed, once the customer is connected, and do not vary either with the demand or energy consumed. Classes are sometimes made according to size of installation, a higher customer charge being made for large loads to cover increased cost of meter and service, but once the customer charge has been determined it is levied the same each month irrespective of what load customer has taken.

Following are the rate clauses from the contract of a large company using the Doherty rate in conjunction with a winter and summer schedule:—

The rates for electric service shall be from the month of October to the month of March inclusive, under the Winter Schedule so-called, and during the months from April to September inclusive, under the Summer Schedule so-called.

Dependent upon the consumer's maximum demand during any winter month within the term of this contract, his rates shall be under Class I, Class II. or Class III, as hereinafter provided; and the consumer agrees that, should the maximum demand in any winter month exceed that fixed for the class under which his rates have previously been computed, he will automatically pass to the class within which said higher maximum demand occurs, and remain in this class for one year thereafter, unless this contract is terminated in accordance with the provisions made therefor hereinafter.

Should his demand during any summer month exceed the demand fixed for his class as hereinbefore provided, such demand shall determine his class for that month only.

The classes are as follows:—

Class I—Maximum demand from 7.5 kilowatts up to and inclusive of 25 kilowatts.

Class II—Maximum demand from 25 kilowatts up to and inclusive of 75 kilowatts.

Class III—Maximum demand above 75 kilowatts.

The consumer agrees to pay monthly the consumer charge hereinafter provided, in consideration of the company's continued readiness-to-serve; and in addition thereto agrees to pay monthly the demand charge per kilowatt for the maximum monthly service taken at the rate hereinafter provided; and in addition thereto for energy utilized one cent (1c.) per KW.H.

	CLASS I	CLASS II	CLASS III
Monthly Consumer Charge:			
Summer (Apr. to Sept. incl.)......	$2.50	$18.75	$127.50
Winter (Oct. to March incl.)......	2.50	21.25	152.50
Monthly Demand Charge:			
Summer (Apr. to Sept. incl.)......	3.00	2.35	.90 per K.W.
Winter (Oct. to March incl.)......	3.60	2.85	1.10 per K.W.

The advantage of the Doherty rate, over the Hopkinson rate, is that it protects the Central Station in the case of customers whose demand and energy consumption varies, dropping at times to a point where the Hopkinson rate does not bring in sufficient revenue to cover the "consumer costs" mentioned above. Moreover, the consumer costs can be assessed more correctly against each customer by means of a separate charge, protecting the station against unprofitable customers and encouraging profitable business.

The only disadvantage seems to be the popular objection to the consumer charge as a charge for which the consumer receives nothing. This may be overcome by explanation as to the nature of the costs it covers in each individual case, or by educating the public generally. However, until the theory of rates is put into clearer form and agreed upon generally by the electrical profession, the task of educating the public is likely to prove difficult.

Theoretically, the Doherty rate is superior to any other form of rate, and has been less criticised. In practice it is much less used than the Hopkinson rate in its various forms.

FORMS OF LIGHTING RATES.

Straight Line Meter Rate.

Applicable to any method of charge for electric service which is based on the amount used. This amount is expressed in such units as KW.H., and watt-hour meters are used. The price charged per unit is constant; *i.e.*, does not vary on account of any increased or decreased number of units. The total sum to be charged is obtained by multiplying the total number of units by the price per unit.

Example of contract clause providing for such rate:—

The consumer agrees to purchase current at the rate of 10 cents per 1,000 watt hours.

(NOTE.—Where a discount is allowed with this rate it is a fixed percentage or number of cents per KW.H., not varying with larger or smaller consumptions.)

Illustration: A consumer has taken 100 KW.H. Rate is 10 cents per KW.H. Charge $= 100 \times 10 =$ \$10.00.

The advantages of this form of rate are, first, that it tends to check all waste of energy, such as burning lamps not required, and, second, that it is extremely simple in form and readily understood by all customers.

Its disadvantages are that it entirely fails to distinguish between the cost of supplying a large demand and a small demand, between use during hours of station peak and off-peak use, and between the cost per unit for large consumers and the cost per unit for small consumers. It has very little relation to the cost of supplying light for companies generating by steam, and less for hydro-electric companies.

Meter Block Rate.

As used in connection with and applied to any method of charge this form indicates that a certain specified price per unit is charged for all or any part of a block of such units, and reduced prices per unit are charged for all or any part of succeeding blocks of the same or a different number of such units, each such reduced price per unit applying only to a particular block or a portion thereof. The total sum to be charged is obtained by multiplying the number of units in the first block by the price per unit for that block and adding thereto the number of units in the second block times the price per unit for that block, etc., until the sum of the units falling within the different blocks equals the number of units to be charged for.

Example of schedule:—

10c. per KW.H. for the first 25 KW.H. consumed per month.
8c. per KW.H. for the next 25 KW.H. consumed per month.
6c. per KW.H. for the next 25 KW.H. consumed per month.
3c. per KW.H. for any excess use.

(NOTE.—This same form of rate may be attained by making a straight line meter rate accompanied by a discount in block form, but this is not usual. An example would be:—

Rate: 10c. per KW.H.

Discount: For the first 25 KW.H. consumed per month, 0c. per KW.H.
For the next 25 KW.H. consumed per month, 2c. per KW.H.
For the next 25 KW.H. consumed per month, 4c. per KW.H.
For all used in excess, 7c. per KW.H.

Illustration: A consumer has taken 90 KW.H. Rate as in above example of schedule.

Charge:— 25 KW.H. × 10 = \$2.50
25 KW.H. × 8 = 2.00
25 KW.H. × 6 = 1.50
15 KW.H. × 3 = .45

Total.......\$6.45

The advantage of this form of rate is that it affords a convenient means of recognizing decreased cost per unit with large loads by a corresponding reduction in rate.

Otherwise it has all the disadvantages of the straight line meter rate.

Meter Step Rate.

As used in connection with and applied to any method of charge indicates that a certain specified price per unit is charged for all or any part of a specified number of units, with reductions in the price per unit based upon increases in the number of units according to a given schedule. The total sum to be charged is obtained by multiplying the total number of units by the price applying for this number of units or by the primary price and deducting the discount applying for this number of units.

Example:—

For the monthly consumption of
From 1 to 25 KW.H., 10c. per KW.H.
From 26 to 50 KW.H., 8c. per KW.H.
From 51 to 75 KW.H., 6c. per KW.H.
From 76 and over, 3c. per KW.H.

(NOTE.—This form of rate also may be attained by a straight meter rate accompanied by a discount varying according to the quantity consumed.)

Illustration: A consumer has taken 90 KW.H. Rate as in above example of schedule.

Charge:— 90 KW.H. × 3 = \$2.70

2nd Illustration: Consumer has taken 75 KW.H. Rate as in same schedule.

Charge:— 75 KW.H. × 6 = \$4.50

It will be noted from above illustrations that the second customer would have saved \$1.80 by using, or wasting, 15 KW.H. more. Though the above is an exaggerated case, such a condition actually occurs with each step of this form of rate. The reduction in the total bill that may be se-

cured by wasting energy can be limited by making numerous steps, each reduction in rate being small and applying to a small increase in consumption. Nevertheless, the anomaly of a smaller total charge for an increased consumption continues to exist in more or less striking proportions. This form of rate has been widely used, but is being gradually abandoned. It is not recommended by the Rate Research Committee of the N.E.L.A.

The advantage of the step-meter rate is that it provides a convenient method of reducing rate for large quantities.

Its disadvantage is that it does not distinguish between long use of a small demand and the short use of greater demand. Also, it presents the irregular feature noted above.

Wright Demand Rate.

Applicable to any method of charging for energy consumed in which the rate is reduced in proportion to the number of hours maximum demand is used.

Watt-hour meters are used in all cases. The maximum demand may be determined from Wright demand or other maximum demand indicators, or estimated from tests or from connected load. As originally applied in Brighton, England, demand indicators were used, and the average demand during winter months was determined from monthly readings of indicators and taken as demand for each month of year.

This form of rate is largely used for commercial lighting, the demand being frequently taken as rating of connected load and on demand indicator used.

Illustration:—

Rate: For the first 30 hours' use per month, of maximum demand, 10c. per KW.H.

For all used in excess, 3c. per KW.H.

Charge for a consumer who has taken 90 KW.H., and whose maximum demand has been ascertained to be 2 KW. =

60 KW.H. at 10c. = \$6.00
30 KW.H. at 3c. = .90

Total........ = \$6.90

This rate form may be also attained by a straight meter rate, accompanied by a discount based on the number of hours maximum demand is used during the month.

The advantage of the Wright demand form of rate is that it takes into consideration the maximum demand as well as energy consumed, yet is simple in form and acceptable to the average lighting customer.

Its chief disadvantage for residential lighting lies in the extra investment required for a demand indicator and trouble fixing demand. Where no indicator is used and demand is estimated from connected load it is difficult to keep any satisfactory check on the connected load. This latter difficulty does not exist to the same extent with commercial loads. A second disadvantage is that it does not allow for demand off-peak, such as created by the use of flat-irons and other domestic appliances.

Two-Meter Rate.

Applicable to any method charging a higher rate per KW.H. for energy used during certain hours than for the energy used during other hours. Used in conjunction with a time switch. Two meters were originally used, the time switch automatically cutting in one meter to register during certain hours (as during hours of lighting peak), cutting out that meter and cutting in second to register load during balance of day. In later developments two registers are used but only one meter, the time switch connecting one register to meter during certain hours, and the second register during balance of day.

With the above method of metering a high charge is made per KW.H. for energy recorded on one register (that register arranged to record during hours of peak load on station) and a low rate per KW.H. is charged for energy recorded by other meter which registers only during off-peak hours.

Another method attaining the same result is to arrange the time switch to cut in and out additional coils on the same meter, accelerating the meter disc during certain hours. In this case the meter is calibrated to read in cents instead of KW.H. and the charge is taken direct from the meter. With this method there is no record to show the amount of energy taken during peak hours and the amount off-peak.

The advantage of this form of rate is that it permits the central station to charge a low rate during off-peak hours, securing business when otherwise plant would stand idle, without reducing its revenue for energy taken during peak hours.

Its disadvantage lies chiefly in the extra investment required for time switch and extra or special meter, an element of importance with small lighting loads, while for large loads it does not take into account the extent of the demand made during hours of station peak.

Flat Rate.

Applicable to any method of charge for electric service which is based on the consumer's installation of energy-consuming devices, or on a fixed sum per consumer, irrespective of the quantity used. Meters are not used.

This rate usually took the form of so much per year for a certain size and style of lamp; *e.g.*, $3.00 per year for each 16 C.P. carbon lamp connected. A lengthy schedule would be given fixing the rate for the various sizes and styles of lamps and domestic appliances, either by affixing a definite charge to each or by rating each as equivalent to a certain number of standard lamps.

Where still in force this rate frequently takes the form of a charge of so much per watt rating of connected load per year. This simplifies the schedule and provides a rate for new appliances and styles of lamp that might not be foreseen in preparing a detailed schedule of prices.

The flat rate was universally used in the early days of the electrical industry, meters not being available. Its defects proved so serious that it has been abandoned in all large cities, and is still in force only in small towns and villages, with possibly a few exceptions for medium size cities where it has survived due to special circumstances.

Its disadvantages are: It is practically impossible to keep even an approximate check on the load connected. This is more particularly true of the larger towns and cities, but applies to all. It encourages long and wasteful use of energy. If the flat rate is high enough to cover cost of long use of connected load (and it must be high enough to cover cost of average use) it is so high as to discourage installation of a liberal number of lamps and of domestic appliances, since customer must pay for lamps and appliances only required occasionally the same rate as covers load used average amount.

Its advantages are that no meters are required, and outside of expense ascertaining connected load the billing expenses are low. The rate also appeals to the customer who knows in advance what his light will cost.

Controlled Flat Rate.

Applicable to any method of charge for electric service which is based on consumer's connected load, or on his estimated demand, and with which some form of controlling or limiting device is used to prevent excess demand.

This rate may be expressed in the form of so many cents per watt per year based on the limiting point of the controller, or it may be expressed as a rate of so much per lamp per year, a lamp being defined as a certain size and style of lamp, with other sizes and styles rated as a proportionate number of lamps. Or a schedule of rates applying to each size and style of lamp may be given. The latter forms are to enable the customer to more easily understand what his charges will be.

In any case the controller is set to limit the maximum demand to the amount agreed upon, whether that amount has been expressed in watts, number of lights, or amperes, and the charge is really based upon the limit so set, though expressed in watts, lamps or amperes, according to wording of contract.

The number of hours a customer may use his demand does not affect the charge made, nor would there be any reduction in charge if he should actually make a smaller demand than that provided for.

The advantage of this form of rate is that it reduces the consumer costs to a minimum: the cost of the controller is considerably less than that of a watt-hour meter, it does not require reading as in the case of a meter, and amount of charge being fixed billing expenses are low. With small lighting loads on meter these consumer costs frequently amount to as much or more than the revenue derived. Another advantage is that revenue does not fall off during summer months. Also it appeals to the customer, who knows exactly what the cost of his light will be. In practice, particularly in Europe but also to some extent in America, it has proven very effective in getting new business in the shape of small lighting contracts.

One disadvantage is that it encourages unnecessary use of light, in the same way as any other form of flat or simple demand rate. For the hydro-electric company with a pronounced peak during lighting hours this is not of importance, and even for the steam-generating company the additional cost would be a comparatively small part of the total cost of such loads.

A second disadvantage is that it discourages the use of domestic appliances and liberal lighting installations, as if the controller is set high enough to permit their use at all the customer must pay for such capacity the same yearly rate as for capacity steadily used. This feature confines the controlled flat rate to the smaller residences and flats.

Demand Rate.

Applicable to any method of charge for electric service which is based on the maximum demand during given period of time. The demand is expressed in such units as KW. or H.P. Maximum demand indicators or graphic meters are used.

While giving the definition of this rate, we are not acquainted with any company using this form of rate for ordinary residential or commercial lighting, though it may be used in connection with large office buildings and hotels.

Hopkinson, or Two-Charge, Rate.

Applicable to any method of charge for electric service in which the price per unit of metered electric energy for each bill period is based upon both the actual or assumed quantity of electricity consumed, and the actual or assumed capacity or demand of the installation.

When applied to lighting, this form of rate is expressed in various ways, the demand, or readiness-to-serve, charge appearing under various disguises.

In its most direct form this rate may be provided for as follows: "The consumer agrees to pay monthly a demand charge of $...... per kilowatt for the maximum demand taken during the month, and in addition thereto ....c. per KW.H. for energy utilized." To obtain the information necessary for billing under such a contract, a maximum demand indicator as well as a watt-hour meter must be installed on the load. The rate is not usually applied in this direct form to lighting contracts, except for large loads.

The demand or readiness-to-serve charge as part of this rate usually appears in lighting contracts as a charge of so many cents per room in residence, or so many cents per 100 sq. feet of floor area. In preparing this rate the average demand and consumption per room, or per 100 sq. feet, is ascertained by analyzing a large number of cases, and from the figures so obtained the central station manager determines the rate per room, or per 100 sq. feet, that will bring in an amount equivalent to the amount per KW. of demand that he has been realizing under old rates or that he wishes to realize. While the number of rooms, or floor area, does not in itself affect the cost of service to the central station, there is a fairly close relation between the number of rooms, or floor area, and the demand made on the central station. Where conditions vary widely from the average this method may not assess the proper demand charge in particular instances, as in the case of a large house insufficiently illuminated. Forms of contract clauses providing for such rates are given below:—

(a) The consumer agrees to pay monthly for such energy and service in accordance with rates on the reverse hereof.

Rate: A service charge of 4c. per 100 sq. feet of floor area, plus a
Consumption charge of 4¼c. per KW.H.

Illustration: A consumer has taken 20 KW.H. and his floor area has been ascertained to be 1,800 sq. feet. (The method of determining floor area should be stated in contract. It is usually the outside area of residence multiplied by number of stories containing living rooms, with frequently an allowance for walls of 10%.)

Charge:—	$1800 \times 4 = \$0.72$
	$20 \times 4\frac{1}{4} = \quad .85$
	Total..... $= \$1.57$

(b) The consumer agrees to purchase electrical energy at 3c. per KW.H., plus 10c. per month for each room in the above premises, with the exception of attics and basements not used for living purposes, hallways, passages, bathrooms, storerooms, verandahs and sheds, and the company reserves the right to count the rooms on the consumer's premises before signing this contract, and from time to time while this contract remains in force.

Illustration: A consumer has taken 20 KW.H. and inspection of the premises has shown that there are nine rooms subject to the room rate.

Charge:—	$9 \times 10 = \$0.90$
	$20 \times 3 = \quad .60$
	Total..... $= \$1.50$

The meter rental charge made in many lighting contracts is in some respects a form of the Hopkinson readiness-to-serve charge, though the amount so charged may be more or less inadequate.

Doherty, or Three-Charge, Rate.

Applicable to any method of charge for electric service in which the charge made to the consumer for each bill period consists of (a) a sum based on the quantity of electric energy consumed, (b) a sum based upon the actual or assumed capacity or the demand of the installation, (c) a charge per consumer.

This rate is practically the same as the Hopkinson rate already described, except that it divides the readiness-to-serve charge of the Hopkinson rate into two elements—one based on the maximum demand made by consumer; the second, the consumer charge, assessed direct against each consumer, irrespective of his demand or average consumption. This consumer charge is designed to cover fixed costs on investment in meter and service run to each customer, expenses reading meter, and office expenses for billing and collecting.

The difficulty and expense of determining maximum demand for small loads has prevented the adoption of this form of rate for residence lighting. Where the maximum demand is estimated according to some arbitrary method, as from number of rooms in house, the demand rate can be made to cover the consumer costs. The more accurate classification of costs on which the Doherty rate is based is therefore of no practical advantage for small lighting loads, and this form of rate is confined in practice to motor loads and large lighting installations.

DISCUSSION.

THE PRESIDENT: We feel deeply indebted to Mr. Wills of the Committee on Rates and Forms of Contract for the time that he has devoted to his subject. Mr. Wills was brought in as a member of the committee at a late hour and has since devoted his time and attention, which meant a great deal of very hard work. This report, of course, will be published in the proceedings of the Convention, and represents a lot of deep thought on the part of this committee, which is an active one. You all realize that rates and forms of contract at the present day are becoming a very serious factor in the success of electrical companies, and I am sure when this paper is published you will take it home and read it with very much interest.

If there are any questions to ask or any discussion on the report I would be very glad to hear them.

MR. WILLS MACLACHLAN: I would move that any discussion on this paper be left over until to-morrow morning and combined with the discussion on Mr. Davies' paper on "Maximum Demand." I am sure Mr. Wills will be only too pleased to let anyone see the paper so that they can prepare themselves for any discussion. More full discussion might be brought to-morrow morning than at this time.

MR. D. H. MCDOUGALL: I second that. (Carried.)

THE PRESIDENT: The report of the Commercial Committee should now be presented. Mr. McIntyre of Ottawa, Chairman, is coming but has not probably arrived yet.

In the meantime we will be glad to have a report from Mr. A. A. Dion, Chairman of the Meter Committee.

REPORT OF METER COMMITTEE.

OTTAWA, June 20th, 1914.

To the President and Members of the Canadian Electrical Association.

GENTLEMEN:—The Meter Committee having considered the thorough work done by the N.E.L.A., as shown by their report brought out at the convention in Philadelphia a few weeks ago, and the fact that Messrs. G.W. Magalhaes of Toronto and P. T. Davies of Montreal had agreed to contribute to the subject at this meeting, in the form of papers to be read and discussed, there seemed little more for the Meter Committee to do; however, it seems that the committee could do useful work during the coming year by covering such investigation and study that is not included in the work of the N.E.L.A., thus supplementing their work instead of duplicating it, to the advantage of all. For instance,—while the N.E.L.A. Committee will continue to study maximum demand indicators, and no doubt make a very thorough investigation of all such devices of American manufacture, we might supplement their work by studying maximum demand meters or indicators of European make.

A letter was sent to member companies about a month ago asking a few questions regarding these instruments—whether a curve, a printed or pointer indication was desired—whether the kind of record should be gov-

erned by the kind of load; whether these records should be integrated for a certain period and averaged, or what duration of peak should be excluded in arriving at the maximum load.

We regret to say that there were only four answers received to this communication, so that it was impossible to form any idea of the opinion of our operating managers and engineers on these points.

This work should be continued during the coming year. Several European instruments have been brought into the country, and more can be had for the purpose of investigation. We also think efforts should be made to obtain some of the small, cheap demand controllers or limit devices used for supplying small customers for light in Europe, as fully reported by Mr. S. E. Doane in a recent article printed and submitted at the recent N.E.L.A. Convention, as the result of his own observations and inquiries These instruments should be investigated, as undoubtedly there is a field for them in obtaining a class of business which has been neglected in many places, and which we must consider now, because where rates are being reduced and tungsten lamps driving out the carbon lamps, it behooves all operating companies to neglect no field where current consumption may be promoted.

There are other matters for the Meter Committee which cannot be covered by the work of the N.E.L.A., for instance standardizing the meters used in Canada as to connections, recording dials, etc. Anything that may be done with the manufacturers towards standardization, must receive the approval of the Minister of Inland Revenue, and therefore it must be carried out in Canada, independently of the American Association.

Apart from any defects in maximum indicators, the matter of cost has been one of concern to the companies. Recently, instruments have been placed on the market in which the integrating wattmeter and the maximum demand indicator are combined. These should be studied, and if they prove to be quite satisfactory in use, this combination, when fairly introduced, may prove to be cheaper than providing two separate meters, namely, one to register the consumption and the other to indicate the maximum load.

We recommend, therefore, that a Meter Committee be appointed for the coming year.

Respectfully submitted.

A. A. Dion,
Chairman Meter Committee.

DISCUSSION.

The President: You have heard the report of Mr. Dion of the Meter Committee. We will be glad to hear any questions asked or any discussion.

Moved by Mr. McDougall, seconded by Mr. Mudge, that the report be received and adopted. (Carried.)

The President: Report of the Public Policy Committee, of which Mr. Dion is Chairman. I think that report had better be read by him to Class A members on Friday. It refers particularly to Class A members and will be an interesting report for that meeting.

I will be glad to have the report of Mr. Hood, Chairman of the Committee of Standardization of Line Construction.

A. B. HOOD: This report is quite lengthy and one which really does not permit of being read, excepting the first few pages. I have with me two full copies of report and blueprints of drawings. After the meeting I will leave them on the table at the rear of the room, so that anyone interested can take the time and look them over. The committee is more than anxious to have criticism and suggestions on the report.

The Report was then read. Owing to the fact that it is profusely illustrated with diagrams and drawings it has not been found possible to reproduce it *in extenso* in these Proceedings. It is, however, on file in the office of the Association for consultation by members.

THE PRESIDENT: Mr. Hood is to be congratulated upon his report, which, of course, is the report of the committee. And it is most creditable when you consider—and, in fact, Mr. Wills' report must be classed similarly—that these committees were appointed almost at the eleventh hour. Owing to the doubt as to whether our Association would be alive by this time, the appointing of committees was deferred. For that reason we have asked the Nominating Committee at this Convention to consider the retaining of the personnel of the present committees for the incoming year, and we have not expected many reports on account of the late appointments. It is, therefore, particularly gratifying to feel that the members of the various committees have been so energetic, and we can realize to a certain extent how much more work they would have done and could have done had they had the full 12 months in which to operate.

We would be very glad to hear any questions asked or any discussion with reference to Mr. Hood's paper. If there is no discussion, it is moved by Mr. Mudge, seconded by Mr. Dion, that this report be adopted. (Carried.)

If there are no further committee reports to present, we will proceed with the reading of the first paper by Mr. Chubbock, of the Canadian Westinghouse Company, on "Modern Switching Equipment."

MR. CHUBBUCK: During the last ten years a large number of fine power plants have been erected in Canada. The switching equipment in many of these stations represents the most up-to-date practice. I will show a few lantern slides, showing sections through the switchboards in most of our important stations, and will endeavor, in a few words, to point out the distinctive features of each equipment.

Mr. Chubbock's paper was then read. It is not reproduced in these proceedings, in view of the fact that a long review of it appeared in the CANADIAN ELECTRICAL NEWS, with cuts, and has probably been read by most of our members.

THE PRESIDENT: I am sure you all agree that we owe Mr. Chubbock our sincerest thanks for the work that he has put upon this paper. It has been very interesting throughout, and having the pictures has been a decided relaxation.

If there are any criticisms or questions to be asked, we would be glad to have them now.

MR. McDOUGALL: I would just like to ask Mr. Chubbock what the frequency of that Hamilton station is.

MR. CHUBBOCK: The frequency is 66 2-3 cycles. This was fixed by the fact that this plant will operate in parallel with the customer's present system at this frequency.

Mr. J. J. O'DONNELL: In regard to the ammeter which you have connected in the high tension circuit, have you experienced any trouble from electrostatic discharge in regard to the correct reading of the instrument?

MR. CHUBBOCK: I don't know of any.

MR. O'DONNELL: You find they register satisfactorily?

MR. CHUBBOCK: Why, I believe so. They are not intended as a very accurate meter, but as a result of tests in the factory we find no objectionable effect from static.

THE PRESIDENT: If there is no further discussion of the matter we will adjourn for lunch.

Adjourned at 1 p.m. to 2.15 p.m.

On resuming at 2.15 p.m.

THE PRESIDENT: We will now have the paper of Mr. G. H. Montgomery, K.C., on "The Legal Aspect of Interference Between Systems of Electrical Companies."

MR. G. H. MONTGOMERY: Mr. Chairman and Gentlemen, I have to express my regrets that I was not able to get my paper completed in time to have it printed and circulated among you. Circumstances unfortunately made it impossible, but I wish to say, in justice to the officers of your Association, that the fault was not due to any lack of diligence on their part or any failure of reminders.

LEGAL ASPECT OF INTERFERENCE BETWEEN THE SYSTEMS OF ELECTRICAL COMPANIES.

By G. H. Montgomery, K.C.

While the American Reports are full of cases dealing with this important subject, very little attention has been paid to such Canadian cases as have been decided, and as the subject is one with which an operating man is in daily contact, the writer has felt that a few notes upon such of the Canadian cases as have come under his attention would be of interest to the members of this Association.

In large centres, particularly where telephone companies, telegraph companies, tramways and electric light companies, and frequently competing systems of each, are compelled to occupy the same streets, and more particularly where the greater part of the construction is overhead, conflict is bound to arise, and the Courts have on a number of occasions been called upon to settle the difficulties between the several holders of conflicting franchises. While the guiding principle has been and should be the reconciliation of franchises so as to permit the operation of all and to prevent anything of the nature of exclusive occupation on the part of any one franchise holder, it is obvious that in the majority of cases superior rights must be conceded to one or the other. As a general rule, priority of occupation will give such superior rights, and any company going into a field already occupied by another company operating an electrical franchise will be held to respect the rights of the prior occupant and to so arrange its system as not to interfere with that of the earlier occupant. This principle, however, suffers certain exceptions either by reason of the nature of the franchise or having regard to the reasonableness of the occupation or the system employed by the first occupant. Deiser, in his work, "Law of Conflicting Uses of Electricity and Electrolysis," has summarized the principles as follows:—

"The street railway is a dominant franchise in city streets. It is a burden upon country highways.

"The construction and operation of the street railway cannot, in normal cases, be enjoined by any other franchise holder, merely because the exercise of the franchise is harmful to it.

"Telephone and telegraph companies may procure a certain degree of immunity from disturbance through induction by using the McCluer device or the complete metallic circuit. Such a company, therefore, can obtain no relief from the Courts unless it can show that it is maintaining its plant at a state of efficiency consistent with modern development in electrical apparatus. The Canadian cases suggest a test in this connection that seems final. A company not making use of such appliances is certain to be disturbed sooner or later by some electrical franchise, street railway,

electric light or electric power. It cannot hope to exclude forever all other franchises from its territory merely because it fears disturbance when it has voluntarily kept its own apparatus at a low state of efficiency.

"All direct trespasses may be restrained. All wanton trespasses may be restrained. It is probable that the direct injury of apparatus or property by escaping currents of electricity is actionable both in England and the United States.

"The location of wires and other apparatus will almost invariably be controlled in such a manner as to harmonize the operation of both franchises."

These principles were applied by the Quebec Courts in the case of The Bell Telephone Company vs. Montreal Street Railway Company, Official Reports 6 Q.B., page 223. There, it was held by the Courts of Queen's Bench:—

"The dominant purpose of a street being for public passage, any appropriation of it by legislative authority to other objects will be deemed to be in subordination to this use, unless a contrary intent be clearly expressed. So, where the operation of a telephone service worked by the earth circuit system was interfered with by a street railway company's adoption of electricity as its motive power, it was held that the telephone company having no vested interest in or exclusive right to the use of the ground circuit or earth system as against a street railway company incorporated by statute, the telephone company could not recover by way of damages from the street railway company the cost of converting its earth circuit system to what is known as the McCluer or common return system—a change which was rendered necessary by the street railway company's adoption of electricity as its motive power."

The judgment of Davidson, J. (now Sir Charles Davidson, Chief Justice of the Superior Court), which is confirmed by the Court of Appeals, lays down the following principles, viz.:—

"Considering that the dominant purpose of a street is for public passage, and that the privileges exercised by defendant expedite public travel and promote the public use to which streets are devoted:

"Considering that while plaintiff is permitted to construct telephone lines along the sides of and across or under the public highways, these lines must not interfere with the public right of travelling on or using such highways (43 Vict., Ch. 67, Can. 1880), and that the business of telephoning while working for the public benefit is an object which must be deemed to be in subordination to the dominant right of public travel."

Following the same idea, Sir Alexander Lacoste, Chief Justice of the Court of Appeals, said:—

"The appellant (the Bell Telephone Company) invokes the priority of its franchises over that of the respondent . . . but we should remark that the appellant by its charter has only a restricted privilege in the streets. It cannot interfere with the public in the use which it wishes to make of them. The streets are above all for circulation, either on foot or in vehicles, and the establishment of a railway for the carriage of passengers, whatever may be its mode of locomotion, is an ordinary use of the streets.

To prevent the establishment of a system of transportation of this nature would be to diminish the rights of the public. Without doubt, a railway should avoid as far as it can reasonably do so causing any damage to the telephone company, but it is for the latter to protect itself and to accommodate its system to the inconveniences which are inevitable."

On the other hand, in an earlier Ontario case between the telephone company and an electrical company (Bell Telephone Company vs. Belleville Electric Company, Queen's Bench Division, 12 Ont. Reports, page 571), the earlier occupation by the telephone company as giving a priority of privilege was maintained. There, the Court said:—

"It appears the plaintiffs were in possession of the ground for the erection of their poles, and that they had their poles erected about two years before the defendants put up their poles. That, however, did not give them the exclusive possession or right to use the sides of the roads on which they had placed their poles, even if they had the independent right to use the sides of the roads under the Dominion Act, without the consent of the municipal council. It is not necessary to say whether the Dominion Act or the Provincial Act is the Act under which the plaintiffs had the right to exercise their powers—that is, whether they have the right to use the road sides for their poles without the leave of the municipality, or only with such leave according to the Ontario Act.

"It is sufficient to say that being in the earlier possession of the ground required for their poles the defendants have not the right to interfere with or do any act to the injury of the plaintiffs' earlier right. The defendants would not have the right to cut down or remove the plaintiffs' poles, nor to make use of them, nor to place wires or do anything else which would damage the purpose or usefulness of the poles or wires which the plaintiffs had placed there; nor to render useless or prejudice the business which the plaintiffs were and are authorized to carry on by means of their poles and wires; nor to cause danger to life or property by stringing their wires so near to those of the plaintiff that life or property is endangered thereby."

A somewhat similar decision was subsequently rendered in December, 1907, by Mr. Justice Riddell in the High Court of Ontario in injunction proceedings between the Canadian Pacific Railway Company, *et al.*, vs. Falls Power Company. There, the C.P.R. and the Bell Telephone Company had been using the same line of poles in the Town of Welland for the carriage of their telegraph and telephone wires. The Falls Power Company having received permission from the Town by By-law, commenced the erection of a line of poles through the telegraph and telephone lines with the intention of over-building the latter and carrying distribution and transmission wires of 2,200 volts and 12,000 volts respectively over the telephone and telegraph wires. In some cases it was proved that the poles actually touched the existing wires. Mr. Justice Riddell found upon the evidence that it would be certain to cause substantial interference not only from the leakage during wet weather, but by reason of the fact of the linemen being obliged to ascend from time to time through the telephone and telegraph wires. He also found upon the evidence that there was grave danger of the high voltage wires falling upon the telegraph and telephone wires. Upon

this finding on the facts he held that the permission granted by the municipality was not a sufficient answer to the complaint made by the telegraph and telephone companies, and that no power exists by which a municipality under the Ontario Statutes can permit one company to interfere prejudicially with the property of other companies. He accordingly granted an injunction restraining the defendant from erecting or maintaining poles for the carriage of wires intended for conducting electricity in a line with and between the poles of the plaintiffs or either of them, and stringing wires thereon over or parallel to the wires of the plaintiffs or either of them, and also directing the defendant company to remove the poles already erected.

As between competing electric companies, what is known as "the three-foot rule" has been laid down and more or less consistently followed by the Courts of the Province of Quebec. This rule is first found in that Province in a very elaborate judgment delivered by the Court of King's Bench in the case of the Jacques Cartier Water and Power Company vs. the Quebec Railway, Light and Power Company, Official Reports, 11 K.B., page 511. *Held*, reversing the judgment of Andrews, J.:—

"1. When the legislative authority gives to two or more companies similar powers to be exercised in the same territory, the Courts must necessarily conclude that the legislative power in question wishes to give them concurrent powers; in such a case, the Courts being bound to submit to the legislative power, should not intervene between these several companies except when one of them trespasses upon the acquired rights of the other.

"2. Three feet seems to be, according to the experts or connoisseurs in the matter, a sufficient distance to avoid all immediate danger."

In the Lower Court, Mr. Justice Andrews had gone very much further, and after referring the case to experts he had ordered the defendant company, which was the later in occupation, to remove its wires, upon the ground that the suggestions made by the experts for the diminishing of the danger involved such an interference with the property, poles, wires and appliances of the plaintiffs as rendered their suggestions impossible of adoption, and that their adoption would not in all cases protect them from danger and detriment.

His opinion was shared by Mr. Justice Cimon in the Upper Court, who held that the rights of the first company comprised not only the space occupied by its poles and wires, but also for the purposes and during the existence of its line "all the space upon the earth and in the air reasonably required for the maintenance and exploitation of this line." He also denied the right of the second company to attach the wires of the first company to its posts by means of insulators.

The majority of the Court of Appeals, however, held that it was the duty of the Court to reconcile the two charters, both having been granted by the Legislature, and in consequence modified the judgment to the extent of obliging the later company to move all posts and wires which were less than three feet from those of the earlier company. The majority agreed, however, with the opinions of Andrews, J., and Cimon, J., to the effect that

they could not oblige the earlier company to attach or allow its wires to be attached to the poles of the later company. This case was decided in 1902.

This "three-foot rule" was subsequently followed by Mr. Justice Charbonneau in 1910 in a case between the Montreal Light, Heat and Power Company, the Town of Maisonneauve, and the Dominion Light, Heat and Power Company, where the Court on demand for an injunction enjoined the Dominion Light, Heat and Power Company "from placing any poles, wires or other apparatus within a distance of less than three feet from the poles, wires and other apparatus of the company petitioner."

On a subsequent application in the same case made in February, 1911, upon the company petitioner's complaint that the respondent company had violated this order by running its poles through the wires of the first company and over-building its lines, the Court held that it was impossible to permit the building of one aerial line over another, without at the same time authorizing one of the two companies to make use of the apparatus of the other company, or without establishing a joint use of the same apparatus, the word "apparatus" evidently being used to mean poles. The Court held that it had not the power to order such a species of partnership or to create a servitude upon the poles and wires of the other company, and accordingly ordered the removal of the poles and wires complained of.

In a later case decided in the same year by Mr. Justice Davidson between the Montreal Light, Heat and Power Company and the Montreal Electric Company, the Court held that the fact of running poles through the earlier wires or attaching side blocks to the earlier poles constituted such an interference with the petitioning company's rights as to entitle the latter to protection:—

"I entirely adopt the remarks made by Andrews, J., in the Jacques Cartier case at page 524. He said that when an electric company is in occupation of streets or portions of streets or public places of a city prior to the advent of another electric company, such prior occupation, while not creating exclusive rights, is entitled to protection and to maintenance so far as such possession is a reasonable one."

The order of the Court ran as follows:—

"*Firstly,* doth order and enjoin the respondents:

"1. Within one month from the service upon them of the present judgment to remove:—

"(a) All poles which project through the wires of petitioners;

"(b) All wires whether primary or secondary (the latter term including wires from transformers into buildings and wires carrying less than 600 volts) which are within three feet of the primary or secondary wires of petitioner's existing system;

"And in default of the respondents complying with the foregoing order, within two months of the service upon them of this judgment, doth authorize the petitioner to cause the same to be removed at the cost and expense of respondents.

"*Secondly,* the Court doth enjoin and restrain the respondents

"(a) From erecting poles projecting through the wires of petitioners;

"(b) From running wires or transmitting electric currents, whether primary or secondary, at a less distance than three feet from the primary or secondary wires of petitioner's existing system.

"*Thirdly,* doth reserve to the respondents the right to apply to the Court in respect of any places or localities where the petitioners occupy both sides of the streets when one side would suffice, or where some unimportant change in the position of petitioner's poles or wires would obviate the otherwise complete blocking of the streets, to the end that in such cases the Court may order as to law and justice may appertain."

The principle that the occupation of the first company must be a reasonable one, and that it will not be allowed to act in such a way as to purposely prevent the later company from exercising its franchise has recently been followed in the Province of Nova Scotia in the case of the Attorney-General and the Town of Truro vs. Chambers Electric Light and Power Company, 14 D.L.R., page 883. The summary of the holding in this case is as follows:

"An electric company will be restrained from arbitrarily and unreasonably lowering its wires for the sole purpose of compelling a competitor, which otherwise could string its wires below the first company's wires and still leave a clear space of three feet, as required by Section 6 of Chapter 130 of Nova Scotia Acts of 1889, and had begun operations accordingly, to re-arrange its entire plant and go above the first company's wires."

The principle which can be gathered from the foregoing cases is that while it is the duty of the Courts to construct and apply the charters of conflicting companies of equal authority in such a manner as to harmonize them and permit the exercise of both, that nevertheless the company which is earlier in occupation is entitled to all reasonable protection and has an acquired right to all the space occupied by its poles and wires to such an extent that a Court is without power to permit a company coming later into the field to make use of the poles and wires of the earlier company even to the extent of attaching side blocks or cross arms to prevent interference.

Before leaving the question of franchises and charter rights, it may be said that the Courts of the Province of Quebec have held on several occasions that it is quite within the powers of a Municipal Council to grant an exclusive franchise for a fixed term of years. As against this, the Privy Council held in 1909 that where a company was incorporated by Provincial Statute with the exclusive right of supplying electricity within a certain radius, that this would not operate against the general powers granted by a Dominion charter, the holding of the Court being:—

"That where a field of legislation is within the competence of both the Dominion Parliament and the Provincial Legislature, and both having legislated, in case of conflict the enactment of the Dominion Parliament must prevail."

The case referred to is that of La Compagnie Hydraulique de St. Francois vs. The Continental Heat and Light Company, Law Reports, Appeal Cases (1909), page 194.

While the principles above given as to the more or less absolute rights acquired by an earlier company were no doubt sound in law, they have been considerably modified in practice by the establishment of Public Utilities Commissions in several of the Provinces with wide powers of regulation. In the exercise of these powers such Commissions have in many cases not only permitted but ordered the joint use of poles.

In the Province of Quebec considerable question has arisen as to how far the establishment of the Public Utilities Commission with powers conferred upon it has interfered with the jurisdiction of the Courts.

In a comparatively recent case of the Quebec Railway Light, Heat and Power Company and the Dorchester Electric Company, Official Reports 23, K.B., page 159, this question came up for the decision of the Court of King's Bench upon an appeal from a judgment of the Superior Court where it had been held that the jurisdiction of the Courts had been removed. Here, the Quebec Public Utilities Commission had issued a general order respecting electrical conditions in the City of Quebec to the following effect:—

"1. Wires of different companies or persons, whether of the same class or not, shall not approach within three feet of one another, if strung on different poles and running parallel or are crossing. If on the same poles, twenty-two inches will suffice;

"2. At all points of crossings, proper support shall be provided to prevent swinging, or greater distances than those named above shall be observed;

"3. Extra high tension wires must be at a minimum distance of at least five feet from any other wires;

"4. No wires other than low pressure and signalling wires shall be allowed to approach within three feet of any part of any building, unless required to enter the same, and shall be securely fastened and insulated, if attached to any part of such building by supports of any kind."

The plaintiff company applied to the Superior Court for an injunction claiming that this order had been violated by the defendant. An exception was taken to the jurisdiction of the Court, and this exception was maintained in the Lower Court, where it was held that the matter was exclusively within the jurisdiction of the Commission. An appeal was taken to the Court of King's Bench, with the result that the decision was reversed by a majority of three to two. The majority of the Court held that the general jurisdiction of the Superior Court is not taken away by the powers and jurisdiction given to the Commission, except in so far "as public safety and convenience are involved in the complaint or controversy," and that accordingly the plaintiff had a right of action in the Superior Court to restrain the defendant from stringing wires upon or attaching appliances to its poles as well as to have the defendant's wires removed to a distance from the plaintiff's wires sufficient to ensure that the plaintiff's property would not be interfered with.

While the above collection of decisions is not by any means exhaustive of the Canadian cases, except perhaps in so far as the Province of Quebec is concerned, it is the writer's hope that their compilation may be of some assistance to the members of the Association who are called upon to deal with the principles involved, as well as to those whose duty it is to advise them.

DISCUSSION.

The President: In thanking Mr. Montgomery for his valuable contribution, I trust I will not be imposing on his good nature in saying that I am sure he is ready to answer any questions which are put to him in connection with this excellent paper of his. If there are no questions to be asked, I am sure it will be interesting to those present to have Mr. McDougall tell us about the recent decision in the Ontario Courts in regard to the poles in Toronto.

Possibly Mr. Dion might give us a few interesting words on our experience in Ottawa.

Mr. D. H. McDougall: Mr. President, Ladies and Gentlemen, in regard to the situation in Toronto: In 1884 or 1885 the Toronto Electric Light Company obtained a general franchise from the Province to do a lighting business. Subsequently a contract was obtained for street lighting in the City of Toronto and the poles that were devoted to the street lighting were erected on permits issued by the city, subject to removal on a month's notice. The city contended, in the recent suit, that they had no knowledge that the company had been doing a private business in addition to their street lighting business. The poles used for street lighting were also used for private lighting circuits, and it was proven at the trial—to which I will refer later—that the company had continuously put up a varying number of poles each year for private purposes alone. In 1893 the company applied to the city for an underground agreement permitting them to lay underground conduits for the purpose of serving its customers. This agreement was granted under certain restrictions. The underground agreement recited the fact that the company was already doing a private business, and, in order to extend their business, it was necessary to obtain this additional right for underground construction. The Hydro-Electric System of Toronto started operations about 1911 and took over the city lighting. The City of Toronto ordered the Toronto Electric Light Company to remove its poles from the streets, seeing that the street lighting franchise had expired. This request was answered by the company by saying that they had received the intimation that the city wanted the poles removed, which they concluded to mean that the city did not want to buy them, which the old agreement provided for, and that the company would proceed to remove the poles. This was done; that is, the poles that had been exclusively used for street lighting were removed. The poles that were not actually removed from the streets were moved back in line with the other poles carrying private circuits. The city contended that any poles that the company had up for private purposes were not there with the consent of the city, and that therefore they must be removed. At the trial it was proved that almost every Alderman had, from time to time, demanded that certain extensions be erected for their friends, so that they could get light, new districts built up and that sort of thing, and that the city had thorough knowledge that the company was doing a private business with poles overhead. The solicitors of the company were also able to tie in the overhead rights with the underground rights, which are acknowledged to be

in operation subject to option of purchase by the city of the assets of the company at stated periods. The Court held that the city had full knowledge that the company had been doing a private business by the use of their poles, that they (the city) had not taken any steps to bring about their removal before they themselves went into competition with the company. It was shown conclusively that if the company removed the poles it would hurt their business, and consequently the city would derive advantage by such removal, in its municipal Hydro System. It was proved that in 1918 the city had the option of purchasing the assets of the company and that, by removing the poles before the purchase date, they would very much minimize the assets they would be compelled to purchase. Consequently, the Court held that the company had a right to erect poles, not only in the original city limits, but also in any extension of the city from time to time. In other words, the company's right to erect circuits in subsequent additions to the city limits, which was problematical, was fully sustained, and the victory was a very sweeping one. The city has intimated that they will appeal from the decision in spite of the fact that the judgment was carefully reasoned out and left them practically no grounds whatever to appeal on. That is, every phase in the case was decided in favor of the company. (Applause.)

The President: Any points in connection with Mr. Montgomery's paper that you would like to be made clear upon?

Mr. A. A. Dion: It may be of interest to state that, in the City of Ottawa we had a lawsuit in reference to the question of interference on the part of a company organized and going into business many years after our company had been in operation. They started to erect poles between our poles and string wires on the same sides of the street. We brought on a lawsuit and we finally claimed that if they were to be allowed to use the same side of the street, there should be a minimum distance of three feet between wires, and that in cases where their poles were erected between our wires, their wires should be fastened to our poles by insulators, so that they could not possibly come in contact with our poles, and that the distance between those wires should be something like two feet, so that linemen could pass between them. However, the Court referred the matter to a Board of Arbitrators. And I may say, in this connection, that there was a clause in our franchise agreement whereby the city had a right to use our poles for their purposes. At the time that this franchise agreement was made the only city purpose for which they might require wires was the fire alarm, and, subsequently, they had the street lighting. That came later. At that time they had no street lighting; we were doing the street lighting; but it was held that this right to use the poles could be transferred to others, and the city, by a resolution of council, had granted to the competing company its own rights to string wires on our poles; so that the competing company acquired the rights that the city had been given under our franchise. We contended that the intention of that clause was to cover fire alarm only, or police signals and things of that sort, because at that time the city had not and did not contemplate anything in the nature of electric lighting or power; but the decision of the arbitrators was that the competing

company should be allowed not merely to have poles between our wires, but to use our poles, and we had to submit to that decision finally, and to-day our poles are used by the city, which has bought over and acquired the rights of the competing company. There is competition between the municipal plant and our company and they use our poles. But the decision was this: That they could use our poles, subject to certain regulations to prevent interferences; provided that they gave us the same rights on any poles that they might erect. And that is the situation to-day. They use our poles and we use their poles, subject to certain simple regulations, and I must say that the system has been satisfactory. It has been satisfactory largely because the engineers in charge of the municipal plant are as reasonable as we are, and the greatest care is taken in building lines in proper manner, and there has been practically no cases of interference. (Applause.)

Mr. Chambers, Nova Scotia: The case referred to, the Attorney-General against Chambers Electric Light and Power Company, was really a case of Attorney-General against myself, and I may say that it was one of the most bitterly fought lawsuits ever fought in the Courts of Nova Scotia; it lasted some three days and half one night. The Town of Truro brought action against us and it was acknowledged by all hands to be a draw. The Town of Truro brought the lawsuit for the purpose of embarrassing this company. They were erecting a street lighting system of their own and the Court held that every right that we had under our charter must be respected. But they held that, in lowering wires and changing some poles, that we had acted arbitrarily, and we could not do that. They admitted that we had a perfect right to have done that at any other time, but doing it at the particular time that the town was putting up their poles, we were doing it arbitrarily, and we lost some costs on that point.

Mr. W. L. Bird: We owe a deep debt of gratitude to Mr. Montgomery for his very able paper on this subject. It ought to be referred to a Legislative Committee. Our Executive Committee should look into the question of having a Canadian record of past judgments and some means of keeping it up to date along the same lines as the National Electric Light Association in their Research Bulletin.

The President: I quite agree with Mr. Bird that we are indebted to Mr. Montgomery for his excellent paper. It is gratifying to find a gentleman, as busy a man as Mr. Montgomery is, who is ready to take off his coat and assist us in the way he has done; a man not directly interested in central station work, who will help us in this manner, is certainly to be thanked, and sincerely so, and on behalf of the Canadian Electrical Association I beg to tender our sincere appreciation of his kindness. (Applause.)

I might say that this paper will be a valuable addition to our data and that it is the intention of the Executive to follow up this work and file decisions for the use of member companies. I hope you will find a goodly number of those decisions in our statistical department before a great many years. We again thank you, Mr. Montgomery. (Applause.)

We will now have the paper of Mr. J. F. H. Wyse, on "Safety First." Before this paper is read, moving pictures will be thrown on the canvas.

Pictures were then shown.

MR. J. F. H. WYSE: Mr. President, Ladies and Gentlemen, I am sure we all feel a deep interest in the subject of reducing accidents, and when we consider that there is a fatal accident in Canada and the United States every sixteen minutes, we realize it is our constant duty to be on the alert for our own and our brother's safety.

In 1905, a little girl about twelve years of age, a companion of my eldest daughter, going home from school, ran behind a street car and was instantly killed by a car coming in the opposite direction. This brought the matter very much home to me, and I then and there made up my mind, if the chance ever offered to reduce accidents, it would not be a lost opportunity.

This opportunity offered shortly afterwards, in 1906, when the Ontario Railway and Municipal Board was formed. My firm, then Wyse & Middlemist, was appointed the Board's engineers, and I was given charge of investigating provincial railway accidents and making recommendations for their prevention. Assisted by the most sincere efforts of Mr. Walter McRae, Master Mechanic of the Toronto Railway Company, the Toronto cars were equipped with every device applicable to prevent accidents; this, and the intelligent and careful policy of Mr. James Forest, Claims Agent of the Toronto Railway Company, has resulted in the Toronto trolleys having a minimum of fatal accidents, for any city its size in Canada and the United States, only 13 for last year (1913).

The reward and satisfaction in the work of accident prevention, lies in the knowledge that there are men, women and children to-day, well and happy on your streets, who, had it not been for your efforts in the great movement of "Safety First," would be six feet under the surface.

"SAFETY FIRST."

By J. F. H. Wyse,

Organizer and Engineer, Ontario Safety League.

The term, "Safety First," is said to have been originated by the United States Government, in a nation-wide movement, during 1908, to reduce accidents in coal and metal mines. It is estimated that there were, during the years 1908-9-10 and 11, on account of this campaign, 51,400 lives saved.

"SAFETY FIRST" is the slogan under which many Safety Leagues, Safety Committees and Associations of to-day are conducting vigorous campaigns for the prevention of accidents.

The movement is almost universal (at least as far as civilized countries are concerned). Its objects are good—the saving of life and limb.

HISTORICAL.—For centuries the ingenuity of man has sought out many inventions to perfect machines for almost every conceivable purpose; however, neglecting the greater care and conservation of the finest machine of all, namely, the human being. To produce the finished article, the laborer, the mechanic, the artisan, the engineer—in fact, all the human element used in factories of every description—had been, up to recently, seriously neglected. The wonderful human machine and its care had been held cheaper than the mere mechanical device.

We have to give the little country of Holland the credit for taking the initiative in accident prevention, in a crusade for human safety and for setting the whole world an example in this laudable work. In the year 1893 a few enthusiasts rented a small dwelling, and secured and placed therein some photographs, models, drawings and actual machines, with devices and attachments, showing their dangers and how to avoid these dangers in operation. At the present time this organization occupies a new and commodious building in Amsterdam, opposite the Rjyks Museum.

Berlin was the next to fall in line, and in 1903 established a Museum of Safety Appliances, which stimulated the public interest. Such success was attained by these museums that the Government soon took them over and looked after their maintenance and enlargement. To-day this Berlin Museum is said to be the finest of its kind in the world.

Shortly afterwards Germany established similar museums in Munich and Dresden, and to-day Germany is said to have solved the great problem of public safety. What Germany has done, we have yet to accomplish.

The AMERICAN MUSEUM OF SAFETY, with its head office in New York City, established in 1908, is a vigorous child of this Dutch and German parentage. There are now, at the following places, some twenty-two, or

more, of these institutes for the promotion of Safety and Hygiene—Amsterdam, Berlin, Barcelona, Brussels, Budapest, Copenhagen, Dresden, Frankfort-on-the-Main, Gratz, Helsingfors, London, Milan, Moscow, St. Petersburg, Stockholm, Vienna, Wurzburg, Zurich, Paris (two), New York City, and, last but not least, Montreal.

INDUSTRIAL.—The class of industrial accident prevention is divided and sub-divided as follows:—

1. General—
   - Boilers, Containers, Steam Piping.
   - Power Machines.
   - Transmission, Electricity.
   - Elevators and Hoists.
   - Personal Equipment of Workmen.
   - Miscellaneous.
2. Particular—
   - Mining, Quarrying and Excavation.
   - Blast Furnace and Foundry.
   - Woodworking, Stones and Clays.
   - Paper and Printing; Agriculture.
   - Transportation by Land.
   - Transportation by Water.
   - Metal Working; Building Trades.
   - Chemical Industries; Textiles and Clothing.
   - Foodstuffs; Building Trades.
   - First Aid to the Injured.

In addition to these groups, the operations of the institutes are devoted to:—

INDUSTRIAL HYGIENE.

Covering: Apparatus and Instruments for the Testing of Air, Light and Water; Miscellaneous; Ventilation; Infectious Diseases; Tuberculosis; Water Closets and Lavatories; Exposition of Substances Detrimental to Health; Lighting; Exhaust for Dust and Gases; Baths; Dining Rooms; Clothing and the Personal Equipment of the Worker.

Also

MUTUALITY OR SOCIAL HYGIENE.

Covering: Improved Dwellings; Service Annuities; Foodstuffs; Miscellaneous.

In the Industrials of Europe it is conservatively estimated that the "Safety First" movement has reduced accidents at least 50%, and the work has been done with the firm belief that "Every life saved is a national asset."

Expenses caused by accident are a burden to the taxpayer, and saving along these lines is a "balance on the right side of the ledger."

Dr. Zacher, Director of the German Imperial Bureau of Statistics, makes the following statement:—"One billion marks (nearly $250,000,000) is saved in wage-earning efficiency annually in Germany through our sanatoria, museums of safety, convalescent homes and other forms of social

insurance, by which we safeguard the lives and limbs of our workmen, and prevent the cause and effects of disease, which would lessen their economical efficiency. Some of our industrials and manufacturers are waking up to the fact that prevention of accidents pays, and that it is far cheaper and more economical than compensation."

Dr. Tolman, Director of the American Museum of Safety, and author of a volume entitled "Safety," to which I am indebted for much information contained herein, says:—"A recent case brought to light the fact of how one manufacturer, after the inspector's report had been received, left a floor pit uncovered. Shortly afterwards a workman fell into it, and received $15,000 damages. Literally, a wooden hand-rail at the top of this precipice would have cost $5: the ambulance at the bottom cost $15,000."

In Germany every employer must belong to the trade association of his business. He pays to this association an accident premium, which is an insurance of his workmen's safety, and he, the German employer, knows, after twenty-five years' experience, that any accident is sure to be thoroughly investigated, and the first question asked will be, "Was there a proper safeguard provided?"

The Industrial Safety Campaign has brought about improved illumination and safety in miners' lamps; the safeguarding of emery wheels, buzz planers, grinding wheels, circular saws, band saws, woodworking tools, lathes, cranes, cars used in shops, arc lamps, scaffolds, manholes, steam boilers and valves, and has resulted in safeguarding railway yards, shops and locomotives. One large plant has the following sign:—

"To Men Seeking Employment."

> "Unless you are willing to be careful to avoid injury to yourself and fellow workmen, do not ask for employment. We do not want careless men in our employ."

The United States Steel Corporation employs over two hundred thousand men. Immediately after the year 1906 they started a "Safety First" campaign for the prevention of accidents, and have saved, since then, nine thousand lives and serious injuries, making a total reduction of 46%. This answers the question, "Is it worth while?"

TRAFFIC.—Relative to street traffic accidents. I would like to read you an extract from one of our Toronto dailies, *The Mail and Empire* of May 16th of this year:—

"Safety First."

"To the Editor of the *Mail and Empire*.

> "Sir,—About the letter of R. B. Morley, Secretary-Treasurer of the Ontario Safety League, I would say that public safety, first and always, should be the watchword of the city of Toronto. Mr. Morley remarks, 'We are not a village. We are a large and always growing city, and there are on our public streets dangers that would not be permitted to exist if those in power did their duty.' I speak harshly because I feel very bitterly against those people who have the safety of the general public in their care, and yet hold human life so lightly that their yearly salary is the main thing they think of in connection

with the position. I have to-day, in my house, a man stricken, not to death, but to imbecility. Fifteen months ago he was a grand specimen of splendid manhood, energetic, strong and capable—a thorough business man, who held a position of trust—a man well known and esteemed by all who knew him. He is my husband. He is now, and has been since the 19th of March, 1913, a perfect wreck, his mind a complete blank, and his sufferings are sometimes intense. Can anyone imagine the grief and trial this sad blow has been to us? Is there anything more horrible? Death from a serious accident is bad enough, but imbecility to a man to whom God had given perfect health and splendid intellect! Could anything more dreadful happen to the man himself or those belonging to him? For him, I thank God he does not know, but for those responsible for his condition, God will not hold them guiltless. Therefore, I say, 'Safety First and Always' should be the watchword of Toronto's civic powers.

"Yours, etc.,

"Toronto, May 13th, 1914." ————

Many railways and street railways in the United States and Canada have organized a safety movement to conserve, not only the public, but their own employees. The results have been so successful that it is said, "Once a 'Safety First' movement is started, it is never abandoned, but goes on increasing its work and widening its scope." One of these railroads saved one hundred and seventeen lives and seventy-five hundred injuries in a campaign of some forty months; and a street railway, by letters to automobile owners and teamsters, reduced its street traffic accidents in one month about 40%.

CENTRAL STATIONS AND LINE OPERATION.

There is not much danger around the Central Station if proper precautions are used, but there should be rules to govern the handling of all lines, wires, cut-outs and switches, and these rules should be strictly observed. A good rule for the operator in the station is to cut-out or dead-end a line or section on the order of anyone, but never to cut-in again without orders from the head of the crew or the personal order of the one who called for the cut-out.

The engines, if any are used, should be completely guarded with railings, and all belts should be carefully protected from possible contact.

Every person who handles high voltage wires at any time should be instructed as to the danger, and shown how to break a circuit without endangering his own life, and also should be taught the "Schaefer" method of resuscitation.

For pulling fuses on high tension wires, or replacing same, sticks should be provided with hooks on the end, to ensure a good grip, and rubber gloves should be used always.

When fuses are to be pulled in cellar, or tunnel, or any other place, it is better to have at least two men around. One man should never go into a dangerous place without notifying some fellow workman. On

dynamos and generators rubber mats should be placed around the base for the operator to stand upon while oiling or adjusting the machine.

Where the operator steps upon the base to examine or adjust the brushes or other parts, there should be a secure railing between him and the revolving parts of the machine, and the base should be filled so as to prevent his slipping and getting inside the frame.

Where there are dangerous wires exposed in cellars or tunnels that are forbidden as passages, it is a good scheme to cover the floor with a light sprinkling of whitewash every morning. This will show the footprints of any person who disobeys the orders. Such passages are sometimes very handy short-cuts, and the men will slip through and may get shocked.

Switchboards should be connected up with a double light system—red for live wires and green for safe conditions.

Where knife switches are used, or double end cut-outs, keep a supply of "fibre" plugs ready, and when a switch is pulled for any purpose, block the bars with a plug to prevent some unauthorized person from cutting in while someone is working on the line. I would also recommend putting a card on the switch at such times.

It is best to have the ends of the switchboard shut off with wire gates to keep unauthorized persons from going back of the board.

Rubber mats should be used in front of all switchboards.

Where "Buss Bars" are strung along the sides of the room or through passages, they should be protected from accidental contact by fences or by wire screens. It is a good idea to have all live bars polished, and the safe ones left dark.

A Pulmotor should be part of the equipment of every station, and should be kept always ready for use, and the station employees should be thoroughly and practically trained in its use.

Every Central Station should be provided with "Pyrene" Fire Extinguishers. One-eighth inch ($\frac{1}{8}''$) of Pyrene will stand an E.M.F. of 10,000 volts. "Electrine" or "J. M. Fyro" will answer the same purpose.

It is a good practice in high tension station work always to have two men on duty. The first man should explain to the second what he proposes to do, and have it thoroughly understood by him (the second man) before proceeding with the operation.

Water should never be used on a fire started by cross wires. Have sand ready in the station, and smother the fire with it.

The greater danger from high tension work is outside the Central Station, where lines are handled by linemen, whose familiarity with them seems, sooner or later, to breed contempt or carelessness. How often we see notices in the daily paper like the following:—

> "Montreal, May 18th.—Four men were to-day electrocuted at Black Lake, Megantic County. They were Russians, and were repairing a power line. One man touched a wire carrying 50,000 volts, and the others were killed trying to pull the man's body off the wire."

Or a record of some perfectly innocent person being sent to kingdom come by touching in a house or cellar a wire which had become crossed with

something carrying 2,000 volts or more. The remedy, in my opinion, which would have saved a number of these lives in the past, and will, if enforced, save many in the future, is to carefully ground the secondaries. Before the Canadian Electrical Association, at Toronto, in June, 1908, a paper on this subject was read by Mr. W. L. Macfarlane. The only conclusion to be reached from the digestion of this paper is that secondaries should be grounded. Six years have elapsed since 1908, and as yet Ontario is the only Province in Canada that has any law requiring this very important precaution. I make this statement advisedly, but subject to correction, believing, however, that there are no laws (outside of Ontario) dealing with this matter, unless the Fire Underwriters' or insurance companies' rules may be regarded as such, though these are far from being absolutely mandatory.

Each company should adopt a set of rules for the use of their linemen, and their failure to observe them should be seriously considered as a sufficient cause for dismissal.

Several insulated stands, good rubber mats, at least three feet square, rubber gloves, linemen's safety devices, like the Marshall shields or pole mats, and insulated tools should be provided for outside work. The use of all these precautionary methods should be insisted upon, as rubber gloves are subject to such rapid deterioration, caused by perspiration or holes, as not to be depended upon alone. Too much emphasis cannot be given to the necessity of instructing linemen as to keeping up respiration artificially after an electric shock. I know of a case where, if proper artificial means had been employed, and not so much dependence placed upon the belated arrival of the Pulmotor, the victim might have been saved. Further, relative to artificial respiration, instructions in this direction should include rigorous drills in the actual movements to which they would have to resort in case of accidents.

All experienced linemen, before starting to work on a wire, will touch it lightly and quickly to ascertain if it is alive.

Every wire, whether insulated or not, should be considered as dangerous. Absolutely no credit should be given to outside insulation as an accident preventive. This has too often proved "a delusion and a snare." It would be an excellent thing for the Central Station to run, from time to time, in the daily papers, advertisements dealing with the "Dangers of Overhead Wires, and How to Avoid Them."

In Germany 34% of all reported accidents in 26 years were caused by ladders. Make sure that all ladders used inside and outside the station, or on the line, are provided with safety points or ladder shoes.

GENERAL.

Based upon accident prevention work in the United States, and what they have accomplished, similar work in Canada would effect a vast economical and social saving.

Money is being freely spent by our Governments on Forests, Game and Fisheries, while our wage-earners, when hurt through avoidable accidents, become a burden upon the taxpayer and objects of charity. Would not some of the public money spent to prevent these accidents be a good

investment? Educational and legal prevention of accidents and disease by sanitation is better and more economical than the cost thereof after accidents have occurred. In other words, "An ounce of prevention is worth a pound of compensation."

It becomes more easy to obey rules for safety when their importance and wisdom is realized than if they are to be regarded as mere rules. We must wake up here in Canada, as they have done in some other parts of the world, to the subject of conservation of human life and limb.

There is nothing in the "SAFETY FIRST" Movement of a political or partisan nature. Its aims are to invite all creeds, parties and interests in a universal endeavor to safeguard life and limb. The work is in no sense revolutionary, but proposes to accomplish its objects by sane and conservative methods; to make suggestions, to give warnings, to get the co-operation of *all* the people *all* the time, and to secure their moral and financial support as an investment that has paid, and will still continue to pay.

The Ontario Safety League, formed at the suggestion of the Ontario Railway and Municipal Board, is conducting a vigorous campaign against street accidents. It is almost solely educational, and for ways and means is entirely dependent upon public subscription. The Lieutenant-Governor of Ontario is our Honorary President. His sympathies are thoroughly in accord with the movement, and a number of the best and most representative citizens of Toronto are acting upon our committees, and giving gratis their best efforts to this work. Our affiliated interests are the

Board of Trade, Toronto.
City Council, Toronto.
Board of Education, Toronto.
Separate School Board, Toronto.
Ontario Motor League.
Toronto Railway Company.
Bureau of Labor.
Canadian Manufacturers' Association.
Civic Car Lines, Toronto.
Toronto and York Radial Railway Company.
Toronto Railway Employees' Union.
Playgrounds Association.
Toronto Automobile Sales Association.
Chief Inspector of Factories.
Ontario Railway and Municipal Board.
Boy Scout Council.
Team Owners' Association.
Builders' Exchange.
Canadian Pacific Railway.
Board of Police Commissioners, Toronto.
Boys' Dominion.
Toronto Guild of Civic Art.
Toronto District Labor Council.
Ontario Sunday School Association, and

THE PRESS.

The causes of a great number of street accidents are:—

The rapid increase of our population.

The increased number of high-speed vehicles.

The apparently insatiable craze for speed and haste displayed, often with an absolute disregard of the safety or consideration of others.

The remedies are to educate the public to make SAFETY their first consideration. We teach them:—

Through the columns of the daily papers and periodicals.

By letters and cards of instruction to autoists and teamsters.

By getting the ministers to preach "Safety First" sermons.

By posters and stencilled signs in conspicuous places.

By popular lectures, and by the distribution of circulars, blotters, and "SAFETY FIRST" buttons, and by securing the best traffic legislation and its enforcement.

Lectures and moving pictures to school children are one of the best ways to get at the public, and by the children the idea is taken practically into all our homes, the parents' interest is thereby awakened, and the objects of "SAFETY FIRST" secured.

THE PRESIDENT: Mr. Wyse, I can assure you we all appreciated very much your paper and the illustrations which preceded and followed. I am sure that your task being of such a worthy one, you naturally reap the reward for your good and hard work in the satisfaction that you must receive. We will go on with the next paper as the time is late, which is that presented by Mr. Hood, on "Grounding of Distribution Circuits."

GROUNDING OF DISTRIBUTION CIRCUITS.

By S. Bingham Hood,

Toronto Electric Light Company.

To ground or not to ground has been a question occupying the minds of central station engineers, and the columns of the technical press, for many years.

This question has progressed from the point where it was thought to be criminally negligent to allow a ground on a circuit to that of being thought equally guilty not to allow a ground.

If we go back a few years we find the National Code forbidding the operation of any circuit with a ground on it, then allowing it by special permission; next suggesting that it be grounded; and, finally, in the last edition, making grounding compulsory up to 150 volts, and optional above this pressure.

Almost the entire argument upon which grounding is based is that of reducing the life hazard. What more sound basis for argument could we wish for? However, this is the smallest part of the argument, considered purely from the central station standpoint. True, none of us wish to see our customers transferred to Kingdom Come, or the other place, but we do wish to increase the reliability of our system.

In a system of any size, particularly where the much desired interconnected network of low-tension supply is used, it becomes almost a physical impossibility to keep grounds off the system for any length of time. Many of us here can remember the old days of the ungrounded network (and, I regret to say, some of us are still in the old days), where John Smith's basement light is hard up against a water pipe and he, unknowingly, tests all his neighbor's wiring insulation at double its normal voltage. About this time Mrs. Jones sets her electric iron down on her gas stove (the iron, as usual, being broken down in its interior anatomy) while she interviews the ice man.

Mrs. J. postpones her ironing and Smith falls down his cellar stairs in the dark. Now what happens? Mrs. J. picks up her iron, looks it all over, outwardly, and sets it down where it belongs—on its stand on the ironing board; then sends for the electrician, who calls, looks wise, and says, "Your plug is too small," and puts a 20 amp. on a branch circuit which is only good for six amperes, but will safely carry 15 any old day, and may, as a special favor, now be fused and approved for 10. Bill, 75 cents.

Smith does not believe in electricians, and can't find a new fuse plug, so uses the old one backed up with one of our much-despised Canadian coppers. In addition to curing his trouble, he has established a "permanent and effective" ground on our system and don't care a hang whether it is approved or not.

Probably the next ground is outside somewhere where it has no fuse to blow, and friend Smith loses his cent together with some other of his household effects.

Now, when the Code finally allowed grounding, many of us saw daylight ahead and thought we had the answer to the whole problem by simply putting a collar on our stray cat and chaining him fast at the middle point of our potential distribution. We hunted up some old gas pipe, drove it a few feet into the ground, hooked it up to our neutral and stood back to await the results.

What was the result? Somebody comes along on a nice damp day and leans up against our salvation and immediately dreams a few new dance steps. We send out a trouble man who finds the ground pipe charged, and to find out how heavily, jumps it onto a fire hydrant or car track. Bang! and it is all over and the trap is set for the next victim. This happens a few times and the ground pole gets a bad name. Result, our trouble man cuts off the ground wire and we are back where we started and the old cat jumps over the fence again.

I went through this experience about ten or twelve years ago, and I suppose nearly all of you have had a very similar one or are now in the midst of this continuous performance.

Now, gentlemen, I am going to tell you what I kept a state secret for some years, to save my own neck. If my old chief were here he would now understand why I got such good results from these grounds in my district, and why other districts were meeting with worse than failure. I carefully picked the points for my ground connections and, having all my neutrals tied together, had about a dozen favorite points which I knew would work. I will not attempt to describe all of them, but can recall two which were particularly effective. In one our pole line rested right on the edge of a twelve-inch water main. One pole bore so hard on the side of this that I protected it by a good-sized cast lead plate formed to fit the curvature of the pipe. By accident (?) one end of our ground wire got cast into this plate.

In the other case the owner of a large building closed his contract before he built the building, and to avoid having the service conduit show on the front wall had us build it into the wall as it went up. The 2/0 neutral, again by accident, passed through the wall of the conduit about in the centre of the brick wall and branched off between the courses and finally wound up, literally, around the main water service just before it entered the basement.

The results gained in this way have firmly convinced me that the only permanent and effective ground is direct to a water or other piping system laid in the ground, and to attempt to get reliable protection in any other way is a sheer waste of good time and money.

At first sight it may not appear clear why these driven grounds give such average poor service. Upon closer investigation, however, it becomes very clear as to why they fail. I have made numerous resistance tests on this class of ground, and have found the resistance to vary from five or six ohms, where a ¾-in. pipe is driven seven feet into wet ground, to as high as 180 ohms on a similar pipe in same ground after a long spell of dry weather. Such a ground can only be figured as to effectiveness under its worst condition. A fair average resistance would be 60 ohms. Considering buried plates, ground cones and similar devices, the average resistance will be about one-half of this, owing to their being buried with their active surfaces planted deeper and generally in permanently moist earth. For the same reason their maximum and minimum resistances will not vary nearly as much as in the case of a driven pipe. The chief defect of these latter class of grounding devices is their inability to withstand corrosive action of most soils for a long period of years. This, together with their higher first cost, makes them almost prohibitive for use for the purpose for which they are designed.

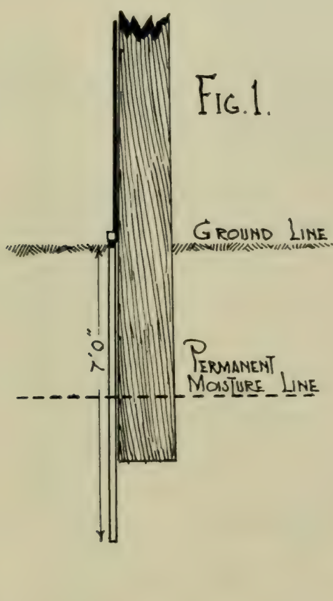


Fig. 1.

Referring to Fig. 1, we have a typical driven pipe ground in which we have seven feet of pipe in contact with earth in wet weather, and about one-half this is extreme dry weather. Under these conditions our ground is only one-half its maximum effectiveness under the latter conditions of moisture. If the soil is composed of sand and gravel we lose practically all our protection in dry weather and reclaim but little in wet weather, as path of lowest resistance is then in top soil only.

Now, assuming a small network protected by one driven pipe with a resistance of 60 ohms. We get an accidental ground on one side of our three-wire system, or on the other wire from that to which ground is connected on a two-wire system. Immediately our ground wire and pipe is raised to 110 volts above earth potential. The potential then decreases to zero through the earth contact with the pipe. From tests made it has been found that this zero potential condition is not established until we get at least a foot away from our pipe. In other words, we have a cylinder of earth with the pipe for its axis. The outer walls of the cylinder are at zero potential and the axis 110 volts above, or below. This explains why a person standing close to a pole where ground exists will receive a shock and not be actually touching either the pole or the ground wire. In high-tension transmission systems using iron poles, or even wooden poles in wet weather, one can get a severe shock by walking within several feet of the base of pole or tower.

One of the first requirements of a successful ground connection is that it must pass sufficient current at 110 volts to at least blow a branch fuse of 10 amperes. One of these pipes will not blow, under average conditions, more than a two ampere fuse; therefore we must provide at least five driven pipes on each section of our secondary network.

The second requirement is to blow the largest fuse in our primary network in the event of a cross occurring between primary and secondary systems. This fuse would probably be, in a fair size system, 150 amperes. One driven ground would pass about 40 amperes, and we must have at least four ground connections to insure proper protection. If the cross occurs in the transformer or on a small fused branch primary line, then one driven ground will protect. This is, however, an exceptional condition, and to obtain absolute protection our grounding system must be of sufficiently low resistance to pass the heaviest current possible to obtain, and also to open up the protective device controlling this heavy current. Applying this rule we will find that, to prevent our ground leads becoming charged with low potential current, due to an accidental ground on the other side of secondary network, we must provide a very low resistance path. For instance, if the heaviest main fuse of any customer is, say, 150 amperes, we will need about 80 driven ground pipes to make our system self clearing. It is clearly impracticable to get such results by this means of grounding, as it would require a ground on every pole along a stretch of line nearly two miles in length, even if we neglect the resistance of such a long length of neutral conductor.

Aside from the impracticability of such driven grounds there is another factor of danger, to both our employees and the public, which enters into their use when installed at the pole base, as generally located. If, in the event of a high-tension cross, the primary protective device fails to open the ground wire and pipe becomes charged to 2,300 volts potential and any one touching it would probably receive a fatal shock. If the condition is maintained for any appreciable time the leakage from ground pipe at ground line to the moist ground line area of the pole will result in setting the pole on fire, and not only damage our construction but attract attention to the

unusual condition and very possibly induce someone to touch the pole, or ground wire, who would otherwise not be called upon to go near it.

The second and ever present danger in this method of grounding, and one which exists independent of the ground resistance, is that of having any uninsulated grounded conductor on any wood pole line upon which high-tension lines are strung. This danger is one which affects our employees to the greatest extent, as they are practically forced to handle high-tension lines on what is to all intents and purposes a metal pole. To ask any linemen to do this is little short of criminal, and numerous fatal accidents have resulted from this practice.

Now compare these crude and prohibitively expensive, as well as ineffectual methods of grounding, to that of grounding directly to a water main on the consumer's premises.

Assume we have a No. 8 service line and that the ground is made by tapping the neutral service line at the building bracket and carrying it down the outer wall and into the basement, where it is clamped to the water pipe. We have a total resistance of at most one-fourth ohm and can pass an instantaneous current of over 400 amperes at our lowest operating potential. Here the capacity for protection is governed entirely by the safe carrying capacity of the ground and service wire. Number 8 wire will carry 60 amperes for a considerable time without dangerous heating, and we can get absolute protection under the most severe conditions from four of such grounds.

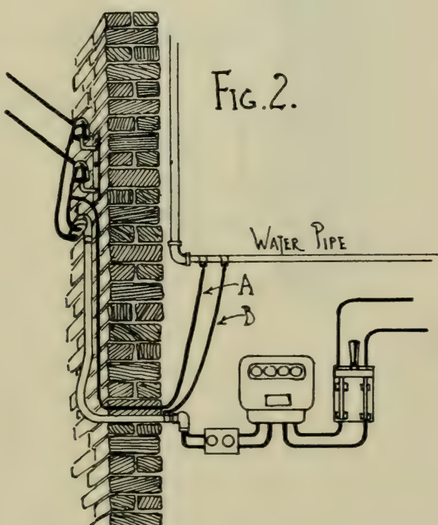


Fig. 2.

The steadily growing standard practice of bringing service into the basement through a service conduit or standpipe simplifies grounding very materially. Figure 2 shows such a service with ground wire carried down

the outside and connected to water pipe as suggested in the Code. This, I think, shows clearly the unnecessary and unreasonable economic waste of this proposed method. The ground wire (A) is clamped to the water pipe. Immediately adjacent to it is another clamp connected to the grounding wire required for the service conduit. The neutral wire inside the stand-pipe is of same potential as ground wire outside, and can just as well be made to serve as the grounding lead as well as the neutral. This service conduit neutral in small installations will probably not be larger than number 12, so more grounds will be required to give safe carrying capacity on a large system. The proper and most economical method of grounding, and one which I have used with uniform success for a number of years, is that shown in Fig. 3. Here we have the service conduit grounded (by the wireman who

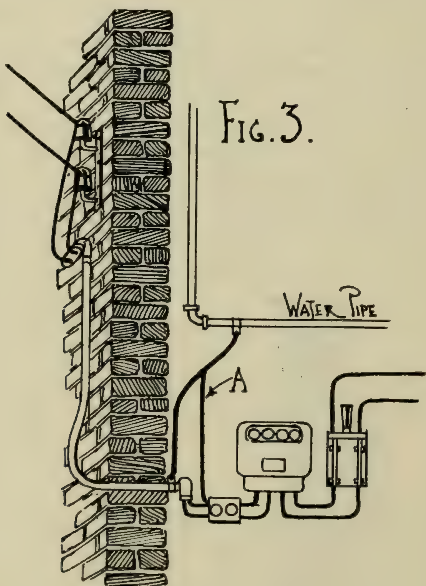


Fig. 3.

installs the job) to the water pipe. The neutral ground (A) consists of a short piece of wire, of same size as service conduit wire, tapped from neutral line lug on service block to a convenient point on the conduit ground wire. This gives a permanent and effective ground at a cost of about 10 cents as compared to probably \$1.50 if run down the outside of building, and probably \$3.50 to \$5.00 if driven pipe is used at pole. At this low cost every service can be properly grounded, as now called for in the Code and Provincial Rules, at an expense so small as to be negligible, leaving absolutely no excuse for further postponement of giving our customers, and the public at large, the protection against injury or death which they have a right to demand.

With such a system of grounding the entire expense would be covered many times over by the damages we would have to pay from one fatal accident. The central station which postpones grounding one day longer than necessary after such simple means of carrying it out are shown to exist, may expect, and heartily deserves, the severest censure and heaviest damage any court can grant.

In those cases where service enters by the old method of porcelain tubes through an upper wall of the building, suitable grounding becomes somewhat more complicated. The usual method is to run a fairly heavy wire, No. 8 or larger, down the outside wall and through into basement to water pipe. It frequently happens, however, that suitable grounding points may be found much closer to the service. For instance, the ground wire may be carried down to opposite a bath-room, where a small unbushed hole may be drilled through wall and ground wire clamped to a section of exposed piping under some of the fixtures of the bath-room. Again, the vent pipe may pass through the roof near the point of service attachment, in which case the ground wire is clamped to vent pipe by a large copper clamp band. Another method would be where a building is piped for hot water heating, in which case the overflow from expansion tank generally passes through the upper wall or roof. The ground wire can be clamped directly to this overflow pipe.

Some of these methods might not be desirable if only one ground were depended upon; but, if we ground every service, we can rest assured that a very large proportion of the ground connections could be more or less defective without materially decreasing the protection to our system or the public safety.

In order to convince our various inspection departments of the absolute safety and reliability of such grounding methods, I would mention that on the system with which I am connected there are over twenty-five thousand customers so protected, and there has never been one indication where any damage or injury has occurred to either persons or property which could be even remotely traced to the grounding method used.

During a period of three years under this method of operating, the total expense for repairs to transformers, meters, service equipment and customers' installations, caused by insulation breakdowns due to both lightning and high-tension crosses, has been less than two thousand dollars.

The period immediately preceding this was one filled with trouble. Meter and transformer burnouts were frequent and serious. Every storm meant three or four transformers to replace and meters by the dozen.

The effect upon the customers' wiring was even worse. Our large secondary networks acted to distribute a high-tension cross over a large area and resulted in simultaneous breakdowns at numerous points. I recall one cross which damaged customers' wiring and apparatus in over fifty places. In this case repairs to fixtures, fittings, and decorations required several weeks' time of a large number of men and involved an expense to the company of over $800.00.

Another case covering a widespread area cost over $3,000.00 to repair; and smaller mixups costing anywhere from one to three hundred dollars were common.

By good luck or an act of Providence we were fortunate enough to have this damage confined to property only, none of our customers, as far as I know, having been injured in any of these catastrophes.

Surely this is evidence enough of the desirability of grounding from an economical standpoint, neglecting the humanitarian aspect of the problem.

We have further utilized this grounding to not only eliminate practically all the usual operating troubles of a large system, but to reduce our distribution investment by over $50,000—and we are not done yet.

In order to thoroughly understand the development of the system and to show the various steps leading up to present distribution standard, we must consider each of these steps in their proper order.

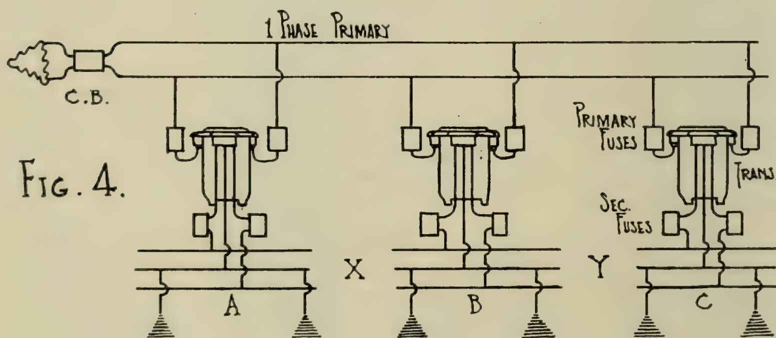


Fig. 4.

Referring to Fig. 4, we have a delta connected primary system from each phase of which single phase primary distributers are taken off through oil circuit breakers. The various secondary networks, indicated as A, B and C, are shown served by a single unit, but in practice were generally each supplied by from two to six or eight units, each of these small secondary networks covering a block of considerable area. At this time it should be noted that the neutral ground connections consisted of driven pipes, three or four to a section.

From time to time additional load was obtained adjacent to the gaps between sections, as at X and Y. Investigation showed that these loads could not be properly supplied from either existing section except by running additional copper or erecting more transformer units. It was, however, found possible to carry such loads, in many cases without additional investment, by connecting these sections together and utilizing the

diversity factor which was found to exist at such points. With the development of the networks these gaps were closed in one by one until an interconnected area of from 150 to 200 K.W. in transformer capacity was obtained, this condition being shown in Fig. 5.

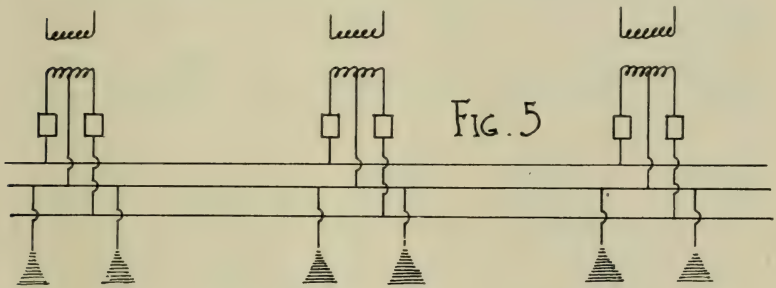


Fig. 5

With the old Fig. 4 arrangement the grounds were not giving good results, as they were not of sufficiently low resistance to blow customer's fuses in case of a ground on an outer on customer's wiring as previously explained. With the interconnection of the smaller networks, giving the Fig. 5 arrangement, this trouble largely disappeared. In the event of a heavy ground or cross, however, conditions were worse than before, owing to the wider area covered by the trouble.

In order to overcome this the practice of grounding directly to water pipes, by method shown in Fig. 3, was adopted, placing one such ground connection every 300 or 400 feet on the secondary main. This immediately stopped all further trouble on the customers' wiring and largely eliminated meter and transformer burnouts due to lightning or superimposed high-tension currents. No additional primary troubles developed, and there seemed to be a slight decrease in those already known and of former frequent occurrence.

About this time it became necessary to carry, at short notice, a large temporary lighting and power load far beyond the capacity of existing feeders, and on too short notice to permit of installation of additional feeders. In order to do this we made use of a spare bank of 1 to 1 ratio transformers connected delta to star, and supplied the load over an existing three-core cable on the 4 wire 3 phase system, using the cable sheath as a grounded neutral, this arrangement being shown in Fig. 6. The arrangement

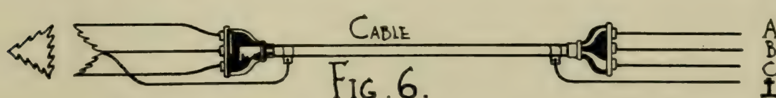


Fig. 6.

ment was found to operate so successfully that it was continued in service, and later on, when the entire system was changed in frequency, the same system was adopted as standard practice, the three phases being run to the

approximate load centre and each phase taken off as a single section supplying one particular area in which all secondary mains were interconnected. This gave three large single phase networks on each three phase outgoing feeder, each section having a transformer capacity of from 150 to 300 K.W.

In several cases bad breakdowns were caused by the breaking of the neutral conductor or the four-wire primary system, resulting in voltage distortion on the separate phases.

This was overcome, as a then temporary expedient, by tapping the primary neutral to the secondary neutral at two or three points, as in Fig. 7, A and B.

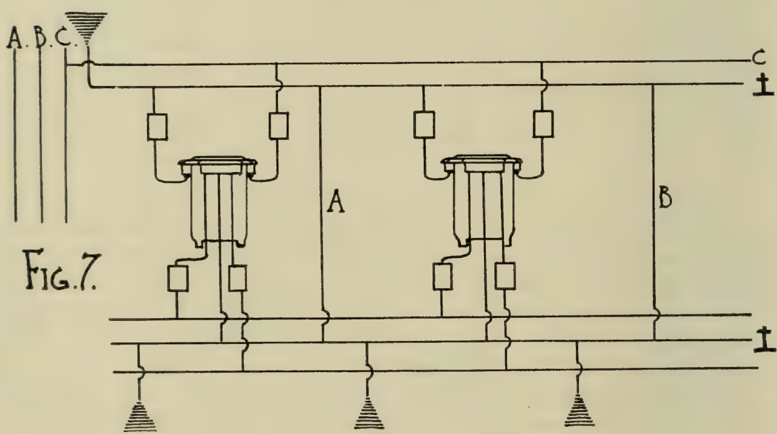


FIG. 7.

Now study this drawing carefully and what do we find? There are two wires of the system covering practically the same area, on the same poles, of same normal potential to earth, and electrically connected together. Is there any good and sound reason for keeping them separate? Why not run one wire to replace the two? This is exactly what we did, and forms to-day what we know as the "Common Neutral System of Distribution." Fig. 8 shows this system as now operated, and in all its simplicity and, perforce, reliability.

By reference to this drawing you will see that we have but one wire to our primary system, with one-half the copper investment and considerably less than one-half the chances for trouble. But one single pole section control switch and one primary fuse block at each transformer, giving an additional saving in investment and lessened chances of trouble in direct proportion to number of contacts through which current must pass.

On the secondary or low-tension side of the system we find no death-traps for our linemen, in the form of ground wires uninsulated and attached direct to poles. On the customers' service the neutral service fuse is either omitted altogether or permanently bridged. This is of particular advantage where three-wire services are taken off for larger customers; as, in such cases, a blown neutral generally means a lot of burned out lamps—and Tungstens cost money.

Such a system, I believe, approaches very closely the ultimate in economy, efficiency and reliability. It would not be possible except by thorough grounding of neutrals, and, I believe, absolutely wipes out any possible objection to such grounding from the standpoint of expense. Can we, therefore, in any way defend ourselves against the inevitable consequences of non-grounding after it has been shown that in protecting the

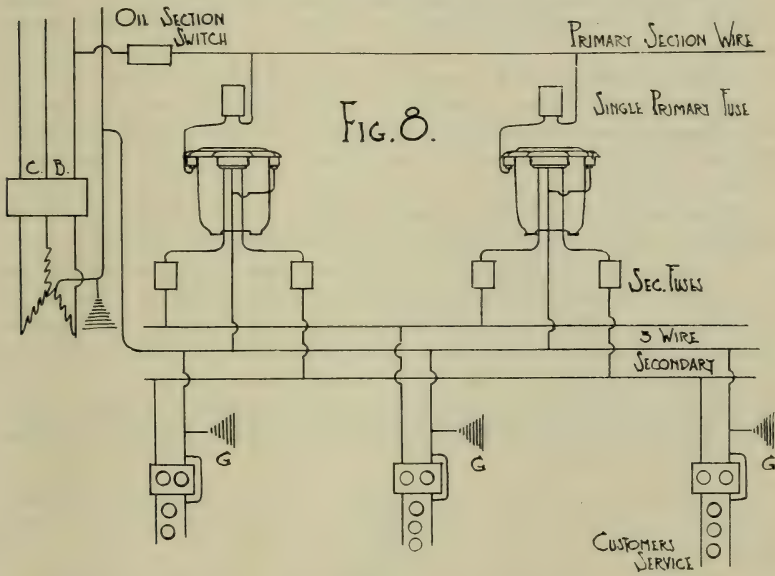


Fig. 8.

lives and property of our customers, we at the same time save ourselves a very considerable proportion of our present and prospective investment?

I would suggest that the various inspection bureaus give this question their careful attention with a view of officially recognizing it as standard practice. The inspection bureaus with which I have had to deal have in all cases unofficially approved of the method above outlined; although it is not in accord with the actual wording, however, it may be in conformity with the spirit of the Code or Provincial Rules. In other words, instead of the established rules leading the system, the system is leading the rules, and the shorter we can make the drag rope the easier pulling we will have.

As a final suggestion, allowing that our neutral is so solidly grounded that it would be almost an impossibility to clear the grounds from it, are we not wasteful in our methods of interior wiring, as well as getting a final installation at maximum cost and minimum reliability?

For instance: What do we gain by putting high-grade rubber insulation on a wire that is permanently operated, grounded, and can be operated in no other way? Why not simply give it a single braid weatherproof covering to prevent corrosive action only and not as electrical insulation in any sense?

Why do we run our common neutral into a building and then split it up into numerous small branches paralleling each other throughout most of their length? Why not make this a common conductor throughout the installation and not only save wire but save 50% of our losses in the branch wiring?

Why should we encourage this waste by going even further and protecting each of these split neutrals with a fuse, knowing that the blowing of this fuse is already responsible for many, if not most, of our interior wiring failures?

If we ground this interior common neutral at numerous places, when it is installed, we absolutely prevent its ever being used for any other purpose but that of a grounded neutral. We need no disconnecting or protecting devices, for the good and simple reason that it never needs testing or protecting.

With such a system we can easily cut our installation costs from 15 to 25 per cent. and our maintenance costs by even a greater amount.

As a paper of this kind would hardly be complete without touching on the question of grounding of circuits whose voltage is higher than that of an ordinary secondary distribution system, I will transgress a few moments more on your valuable time in an endeavor to give you a brief outline of my experience and convictions as to these higher voltages.

There are two factors which enter into the grounding question: First, the life hazard; and, second, the reliability of operation, under which also comes the fire hazard.

Taking up the life hazard, this may be considered as applying only to circuits of from 150 volts to 6,600 volts, as above this voltage it is not good practice to attempt to work upon live circuits.

As to what is a fatal voltage is an open question, and one which depends entirely upon the condition under which one may make contact with the circuit. Numerous cases are on record where shocks from 110 volts have proven fatal; and, on the other hand, shocks at voltages as high as 60,000 have not proven fatal.

In the writer's opinion the whole question of fatality depends on surface contact resistance, and the actual voltage is far from being the governing factor. By the use of an ordinary megger I have made resistance tests of the body and have gotten readings of from 4,000 to 40,000 ohms under different conditions of skin moisture, these tests being made with ordinary voltmeter contacts used as electrodes, giving probably one-half square inch surface contact. Under similar conditions I have found that the resistance between two fingers of one hand is practically identical to that between two fingers of opposite hands, showing that the body itself is of very low resistance and that practically all the resistance is in the skin itself. We can make a number of deductions from these tests. For instance: A shock from one hand to the other will paralyse the lungs before it will affect the heart. One from either hand to the head will produce unconsciousness before affecting any other part of the body. From one hand to any point below the heart line, but on same side of the body, will produce muscular contraction of a severe nature without necessarily affecting either

the heart or lungs. From one hand to opposite side of the body below the heart line will pass current directly through the heart and produce fatal results in the majority of cases. The tests also show that a fractional part of an ampere will, and has, produced fatal results.

With such a widely varying factor entering into the problem, it becomes impossible to draw any line where we shall or shall not ground. For this reason the writer advocates grounding, and grounding solid all distributing and transmission systems irrespective of the operating voltage. We know that up to 250 volts grounding is desirable. On a large 550 volt 3 phase network, supplied from star connected transformers, the neutral has been grounded for several years with a vast improvement in operating conditions over the former delta connected ungrounded network. In the ungrounded system it was found to be utterly impossible to keep the network free from grounds for any extended period; consequently, it was a selection between getting a probable shock at 550 volts and a certain shock at 330 volts. At the lower voltage condition pressure to ground was fixed and always known, consequently could be easily avoided.

At 2,300 to 4,000 volts I have already shown that grounding has been found to be very desirable from an operating standpoint. As to the life hazard, practical operation with such a system has shown that the fatalities have been at least no greater, and probably less, from the grounded system at the higher voltage than from the old ungrounded delta system. The answer to this is, I think, found in the knowledge of all the men working on

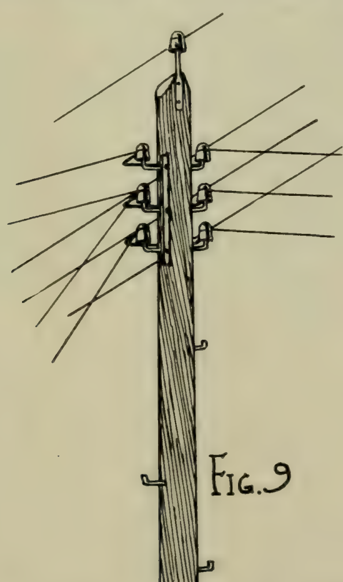


FIG. 9

such a system that they *must take* precautions *which they should take* on an ungrounded system which may develop a ground on any wire at any time.

As an illustration of the improved operating conditions obtainable from a common neutral grounded system, this system has passed through a very severe lightning storm with practically no damage or interruption; while a delta connected system with no primary grounds, and covering exactly the same territory, went absolutely out of business and required several days to get back into normal operation.

This common neutral system has from time to time become crossed with every class of circuit adjacent to it, including 600 D.C. trolley and 60,000 volt transmission, and has come through with all flags flying every time.

On the higher transmission voltages, grounding is, to my mind, equally desirable. The strain on insulators is always to ground and not from line to line. True you have two sets of insulation to depend on in an ungrounded system; but, if we are to believe advocates of non-grounding, the advantage of an ungrounded system is the ability to operate with one line grounded. If this is admitted, of what use is our double insulation if we can limit our maximum voltage to ground to 58 per cent. of operating voltage by grounded star connection?

In a recent report in one of our technical journals, covering 54 systems operating at high voltage, it was shown that 56 per cent. of these used star connection either wholly or in part. Of these but 16 per cent. operated ungrounded, and 37 per cent. operated with solid neutral grounds and the balance through resistance ground. This shows that I am not by any means alone in my contention, and it is my belief that every one of these systems could improve their operation by grounding. Of those operating delta connected I further believe every one of them could star their transformers, ground their neutral, and with same insulators get equally good or better operation and greatly increased line transmitting capacity.

The whole problem of grounding can be summed up in a nutshell. You can easily and economically insulate any circuit for its normal operating voltage, but you can't insulate for any unknown higher voltage, which may be anything up to the highest voltage anywhere adjacent to it. By solidly grounding any circuit you absolutely protect it against any higher voltage circuit with which it may become crossed and absolutely fix your insulation strain to its normal operating value.

DISCUSSION.

The President: This might be properly called a "Safety First" afternoon. After Mr. Wyse's most interesting and entertaining lecture, this following address fits in splendidly. It might have rightly been made part and parcel of Mr. Wyse's paper of "Safety First." This is certainly worthy of criticism and keen discussion, particularly when it was stated by Mr. Williams at the Philadelphia Convention a few days ago that where the secondaries were not grounded, if an accident happened, the company should be held criminally liable, and Mr. Hood proves this to my mind conclusively. However, I would like to hear from those who wish to speak in the matter. The hour is a little late, but we can afford to sit a little longer to-night. We can profitably spend a half hour more together before dinner.

MR. COLEMAN, Port Hope: This has certainly been a very valuable paper, a subject which I have attended more than one convention in order to learn about it. But it still leaves a town situated as Port Hope is—and I daresay a great many more towns are similarly situated—in a way that we cannot make a permanent ground. We are not all favored by having a waterworks system all over our territory. In Port Hope we have not. In the western part of our town we have a deep sand which, as you know, is very liable to dry out very quickly, and in another section we have limestone rock a few feet below the earth, and how we are to put in a good ground in that, I don't know.

MR. A. A. DION: The National Electric Light Association, as you know, has been seized with this question for several years, and after two or three years' discussion of the subject by a committee they finally passed a resolution two or three years ago—I think it was three years ago—recommending that the grounding of all secondaries be made compulsory up to 150 volts, and for higher voltages optional with the companies. They have continued their committee on the grounding of secondaries right along, and this year, at the Philadelphia meeting, they read a report. Their report simply confirmed what they had said before: that they still recommended the grounding of all secondaries up to 150 volts as a compulsory order, and above that voltage as an optional thing. And they also stated in their report that no other grounds should be used, when possible, than a connection to a water pipe, stating that other forms of grounds, such as driven pipes, were too unreliable. That is the stand of the National Electric Light Association on the question. There is a great deal more in this paper; too much in fact to discuss it offhand; but I think it is desirable that this Association should place itself on record about this grounding. It was proposed some years ago that we should do that and the resolutions were not put because of certain companies that did not ground, and it was said that it would put them in an awkward position in case of accident. Well now, several years have passed since that, and if they do not ground by this time I think that they deserve any harm that may befall them. And we should not, for that reason, refrain from approving what seems to be the absolutely correct practice, the grounding of all circuits. There is no doubt that there are difficulties in some cases and that water pipe grounds cannot always be obtained, but possibly some resolution of this Association would help some of the members. Possibly it could not be passed offhand; perhaps some committee might study the question after this Convention and bring in their recommendation. Take, for instance, a case I know of where a company is in competition with a municipality. The company started to ground to the water pipes. It did not ground to the water pipes inside of buildings by going through the wall as is recommended, I think, by the Underwriters and which Mr. Hood has described here as their practice, but the grounding was done by connecting to the water service pipe outside the building, and in order to do this the company sought the co-operation of the City Engineer's Department, which had charge of the waterworks at the time. Instructions were sent to the men under their charge to be careful about these ground wires and not to take them off,

but, if it became necessary to change the pipes, to notify the company to come and take the wire off and replace it later. This worked well for a short time, but changes occurred in the department and then the practice gradually grew of the workmen cutting off those ground wires whenever they came across them, without the knowledge of the company, and the company discovered, on making tests, that so-called water pipe grounds were useless, and they found that they had been purposely cut off. The municipal engineers held that this grounding to water pipes was uncertain because the workmen of the waterworks department were liable to cut them off, as has been shown, and that therefore it was better to depend on the driven pipes, even if they make a poor ground; that even a poor ground is a good deal of protection. Now, we do not agree with that here. I think few of us will deny that if we want grounding at all, we want the very best "ground" obtainable. But the point is, what pressure can be brought through this Association on these engineers to make them fall in line, because if they did, there is no question that the municipality would co-operate with the company in getting for themselves, for the company and for the protection of the public the very best water pipe grounds.

I do not know if Mr. Mudge is here. I think he had something to say in regard to a committee of some kind to continue the investigation of this subject.

Mr. A. L. Mudge: I have a resolution in connection with the matter. I am sure we have all listened with a great deal of interest to Mr. Hood's very valuable paper on this subject. A very important subject it is too. I agree very heartily with what Mr. Dion has said.

The subject of grounding of distributing circuits has been warmly debated for many years, but is now in a very different position from what it was two years ago, as the grounding of all circuits up to 150 volts is now insisted on by the National code and by the law of the Province of Ontario. In view of the above, I would move that one of the standing committees of this Association for the coming year be a Committee on Grounding of Distribution Circuits. Appropriate lines along which this committee might work are as follows:—

1. Obtain information as to Dominion and Provincial laws on the subject, and keep in touch with any legislation, either Federal or Provincial, which may be made.

2. Obtain information from every electric light and power company in Canada, whether a member of the Association or not, as to their experience in this matter, including list of deaths and accidents which have occurred both before and after grounding, their methods of grounding and troubles incidental to same, and how they have been overcome.

3. Obtain information from N.E.L.A. and other authoritative bodies, both American and European, on the subject.

4. Draft recommendations for the advice and instruction of light and power companies as to advisability and best methods of grounding.

5. Make a definite campaign to convince every company in Canada, whether a member of this Association or not, that grounding should be carried out, assisting where necessary by advice and information.

6. Assist where necessary in convincing municipal authorities that no harm can come from grounding to water piping systems.

There may be other lines along which this committee might work. By keeping closely in touch with the N.E.L.A. Committee on this subject the amount of work will be minimized, as the N.E.L.A. has done much valuable work along this line. The work will cost something and an appropriation may have to be asked for, but a few hundred dollars spent in this way will, without doubt, save thousands of dollars to Canadian central station companies.

The President: Might I suggest that you embody in your resolution that they be put under the Accident Prevention Committee. I think that would be proper. I will read the names of that committee, which I hope will be continued. I think we would feel that the work is very safe in their hands, and I might also suggest that the committee ask the Engineering Society of Canada to take the matter up with the engineers of all municipalities to allow grounding to water pipes, and that the grounds shall not be interfered with.

Mr. A. A. Dion: Mr. Chairman, if you will allow me to differ with you. While your suggestion is no doubt a good one, I think the question of grounding is so important that it might occupy a separate committee. There is so much to be done in following out the views expressed by Mr. Mudge in the way of correspondence, getting data, etc., that it could very well form the work of a committee by itself. And besides that, I am aware that Mr. Hood has, for some years, made a specialty of the subject; he has given it a great deal of study, and I was about to suggest that, in naming such a committee, Mr. Hood should be the Chairman of it, and that would be my objection to your suggestion that grounding of secondaries be put in with the other features of this Safety First Committee's work. The Safety First Committee has a lot to do, and while this is related to its work, it might be treated and carried out by a separate committee perhaps to greater advantage. This is only my own personal view of the matter.

Mr. J. S. Gould: I agree with Mr. Dion. I am a member of the Safety First Committee and anxious to do anything to help the matter along, but all this data which has been mentioned by the previous speaker is rather a large load on the Safety First Committee, which, I think, was not instituted exactly for that purpose, and, as has been said by Mr. Dion, it would be better to have a man of the practical and theoretical experience of Mr. Hood on the committee, which would not be the case if left in the hands of the Safety First Committee as it is at present constituted.

The President: I feel sure that the Nominating Committee, when going into the personnel of this committee, will see that Mr. Hood is connected with the committee having that work in hand.

A Delegate: It might be better to have it referred to a Special Committee with Mr. Hood as Chairman.

Mr. A. A. Dion: Is Mr. Mudge's motion then to be put?

The President: You have heard the motion; moved by Mr. Mudge, seconded by Mr. Smith, that this matter of grounding be referred to a

Special Committee with Mr. Hood as Chairman of that committee. (Carried.)

Mr. Hood: Where you have a small town with practically no water system of any kind, there is really only one thing, and that is, a driven ground; but, in order to make the best of it, it really means that all your neutrals over your system must be tied together. The ground conductor must be tied together in order to get all your grounds, even though they be poor, in parallel. We have branch lines in Toronto where we have that condition and we find quite a few of the places put in their own private water system, and we find you get a rattling good ground by hooking on to their water pipe. We also have out there a trolley line, and we use their rails to return—or rather they use our neutral returns I should say—but it seems to work both ways. If you have a trolley line in Port Hope and can get close enough to it to use their rails, that is one help.

A Delegate: I would like to ask Mr. Hood about grounding on gas main instead of water main.

Mr. Hood: Just as good, provided you get on to a large enough pipe so as to prevent burning. What size of pipe?

A Delegate: Three-inch main.

Mr. Hood: You would be perfectly safe.

A Delegate: In our case in Peterboro we own the gas company and we can do as we like.

Mr. Wills MacLachlan: In discussing the question of Port Hope, I might ask Mr. Hood if a coke ground would not be preferable to a driven ground.

Mr. Hood: It is when put in.

Mr. Wills MacLachlan: I might say to Mr. Coleman, where he did not get water mains handy, to put in coke grounds and put it down heavy enough to look after it. We are distinctly against using the driven pipes, from the experience that we have had with them, and I was glad to see the question referred to a committee. I am very much in favor of Mr. Hood's paper and carrying out grounding at the services, but I do not think that we are in a position to say that we should not ground at the transformer at the present time, if we protect the wire in going down the pole, and in that way protect our linemen. I think we are losing a good deal by cutting off that ground at the transformer.

Referring back to Mr. Wyse's paper, which is open for discussion, I noticed that a number of times he referred to the pulmotor. Now, we all know the pulmotor has had a great deal of advertising at the present time, but the Canadian Electrical Association, in affiliation with the N.E.L.A., must recognize the report presented before the N.E.L.A. last year; that, practically speaking, gave the pulmotor a black eye. That report was given by medical men and engineers, and I would like to have a little further information from the medical profession with regard to whether the pulmotor is doing really what is claimed for it, or whether the Schaffer method is a little better.

In connection with our own company I might say that we are using the medical boxes in every sub-station and every local office has a medical

kit or first aid, and we have rules as to the Schaffer method in regard to carrying on the work.

In connection with the accident on the street I noticed that great stress was laid on the street railway and on automobiles. I think there are more accidents caused by bad lighting than any other thing on the streets. And I think that if you will follow up the coroners' reports of the City of Toronto you will find that in every accident, perhaps at night, the street lighting is referred to in some way. I am making a report at a later time with regard to the Street Lighting Committee of N.E.L.A. work, and I might say the one reason of their going into such extensive experiments in New York at the present time is to get good street lighting that will be of aid to any Safety First movement.

Mr. Wyse: In connection with street lighting I omitted to say anything about it, but as a matter of fact we have taken that up with the city authorities in Toronto, and are trying to improve street lighting, especially at intersections where it is particularly poor at the present time. Our efforts have resulted in a number of lights being put in at intersections.

Mr. A. A. Dion: I wish to speak again on what Mr. MacLachlan has said about the pulmotor. The report that was made to the N.E.L.A. in Chicago last year, to be properly understood must be considered in view of certain facts. There was in addition to the pulmotor submitted to the committee another instrument advocated, I think, by an American company, which worked on a different principle, and in upholding the merits of their apparatus this company claimed that the pulmotor was wrong in principle because it was entirely automatic, while in their apparatus the operator directed the inspiration and the expiration, continued each as long as he wished and reversed when he wished, while in the pulmotor it is entirely automatic, and there was considerable rivalry. I suppose the claims of both machines were strenuously advocated before the committee and may have had something to do with their conclusions, but I cannot believe that the pulmotor can injure the lungs, because it only takes a pressure of something like 3 ounces to operate the valve and reverse the flow. That is, air or oxygen is driven into the lungs until the pressure is 3 ounces, when the valve reverses and then the expiration takes place. Now, the question is whether a pressure of 3 ounces is going to injure. I do not believe it. I know of a case where a pulmotor was tried where instead of operating at the rate of about 15 times a minute, as it should, it operated three or four times as fast, and this was explained by the fact that the man had been injured internally, and his lungs were full of blood and there was not room for any more air. As soon as a little air got in, the 3-ounce pressure prevailed and reverse took place. So that you can judge of the capacity, available capacity of air of the lungs, by the rapidity of the action. It is entirely automatic, and what causes it to reverse is the pressure of 3 ounces. Now, would a pressure of 3 ounces injure the lung tissue? I cannot believe that. I am not a medical man.

A Delegate: Going back to Mr. Hood's paper I might make a little suggestion that would serve in the way of advice. I would suggest when you make the grounded circuit you would see how you connect your series

coils on your meter. I recall in one case where I went to see why a meter was no good, and it was the second meter that had been put in that particular place and both meters seemed to operate very mysteriously, neither of them recorded all the current that the electric light man knew must be going through, and yet both of them tested all right at the station. It proved upon inspection that the electric wire circuit at a rheostat was in contact with the gas pipe, and part of the current was being shifted around through the ground on the circuit where the neutral was grounded. So if Mr. Hood's suggestion is carried out that we do a wholesale grounding business, inside and outside, it would be absolutely necessary to be sure that your meters are connected so that your series coils are in series with the outside wire.

Mr. A. A. Dion: Where you have only two wires always put your ground on the right side, so that any leaks will be against the customer rather than against yourself. (Laughter.)

Mr. Hood: I think that point is very well taken. We have had to watch our meters very carefully that way. It is an ideal arrangement for a customer. We have had lots of those mysterious cases where a customer was perfectly honest.

The President: Any further discussion?

Mr. A. A. Dion: I do not like to speak so often, but there was something I wanted to say in connection with Mr. Wyse's paper, because I had the opportunity of hearing a paper on the same subject, a short paper treating the matter generally, by Mr. Paul Lupke at the Convention in Philadelphia, and, if I remember rightly, his contention was this: That the best results can be obtained in the matter of Safety First by education; not so much in the way of making rules or giving long, easily forgotten instructions, but rather by cultivating in a general sense what he called a safety spirit. And if a man acquires this safety spirit you need to give him very few instructions; he will naturally follow the proper line to produce safety. Mr. Lupke gives examples. For instance, a man in a power house trips over a rug in front of a switchboard and gets into a dangerous position. He might use some strong language and go by it. If so, that man has not got the safety spirit. If he had, he would see that the rug was fixed so that nobody else would trip on it. In other words, he would not only try to avoid accidents, but never leave his work in such a way that it could be a trap for someone else. That is the general way in which he thinks we ought to educate ourselves and our employees.

Mr. Wyse: I may say I had the pleasure of reading that paper, and I agree with the sentiment exactly. It has been my experience. You not only have to instil that spirit of safety first into any and everybody, but keep it instilled into them. Keep it there after you put it there, and to do that you have to iterate and reiterate the principles of Safety First.

The President: Before adjourning for the evening I would like to draw attention to the paper which we will have to-morrow on the "Maximum Demand," and then a further report on the Meter Committee of the N.E.L.A. from Mr. G. W. Magalhaes. In this connection we have in this room a meter exhibit. It is not likely that Mr. Magalhaes will refer particularly to any one meter or to any particular meters in his talk, but I understand

that the representatives of the manufacturers of the respective meters are here at the Convention, and I am sure will give any and all information regarding his particular meter to anybody wishing the information.

If there is nothing else I think I will declare the meeting adjourned until to-morrow morning at 9.30.

SECOND DAY—MORNING SESSION.

Thursday, June 25th, 1914.

On resuming at 9.30.

THE PRESIDENT: Mr. Brown, if you come up we will endeavor to make a start.

THE VALUE OF ELECTRICAL HEATING DEVICES TO THE CENTRAL STATION.

By Harold S. Brown,
Canadian General Electric Company.

Central Station men undoubtedly realize to a much greater extent than ever heretofore, the important parts played by electrical heating devices, not only in improving the load factor of your present customers, but also of inducing new consumers to accept the service you have to offer. In the past the introduction and sales of such appliances have been largely made through the efforts of the retail dealer, whose interest usually ceases when the original sale is made and the device is delivered. The Central Station, however, has a more permanent concern in their successful operation, which offers the desired opportunity to obtain a perpetual revenue with fair profits from such a source. The advantages and convenience of one heating device invariably popularize electric service, and often lead to the installation of additional appliances, which materially increases the residential power load, and transfers many a customer from the undesirable to the highly profitable class.

Continual progress and development in design have practically eliminated the objectionable features which were formerly experienced with the use of such devices, so that they are now durable, efficient, and economical. Another distinct advantage is the present popular selling prices of these appliances, which can no longer be considered as luxuries. An increase of fifty or seventy-five cents per month from each one of the many residential customers would obviously result in an appreciable gross revenue to the Central Station. This prospective business is, of course, limited in direct proportion to the number of houses wired for electricity, and presents an added incentive to extend house wiring campaigns to every available residence. The demand for electric flat-irons has been the means of causing many customers to install electricity.

ELECTRIC FLAT-IRONS.

The electric flat-iron has proved the most popular of the electrically heated devices for household use. Several years ago it was found after careful investigation that the average income of an electric flat-iron was approximately 70 cents per month. An installation of 1,000 irons would, therefore, represent an income of $700 per month, or $8,400 per year. When it is considered that many cities and towns have many times this number of irons in actual operation the value of this service is self-evident. The *Electrical World* is authority for the statement that a quarter of a

million flat-irons were sold during the year 1910. This gives an estimated income of over $2,000,000, which is equal to the estimated value of all the electric heating and cooking apparatus sold during that year. The estimated value of such apparatus sold during 1912, as compiled from data furnished by leading manufacturers, was $4,000,000.

At Fort Worth, Texas, 5,000 irons were recently sold during a one month's campaign. At Altoona, Pa., in 1911, the effect of the flat-iron load was especially investigated. On Tuesday, with 4,200 irons in use, the peak load of 1,600 Kw. occurred at 10.00 a.m., and exceeded the evening lighting peak by 300 Kw. It was noticed that the ironing load was also an important factor during Monday and Wednesday. The morning peak was highest on the first three days of the week, being 1,000 Kw. on Monday and Wednesday, 1,600 on Thursday at 11.00 o'clock, 400 Kw. on Friday at 11.00 o'clock, and 500 Kw. on Saturday at 8.00 o'clock. The morning peak of Tuesday exceeded that of Monday by 600 Kw. The load begins to increase at 7.00 o'clock in the morning, and does not begin to drop off until after 5.00 o'clock in the afternoon.

The results shown above are typical of ordinary Central Station conditions when special attention has been devoted to the introduction of one particular device. By means of similar campaigns on other current consuming devices the aggressive Central Station can approximate uniformity in daily loads and thus attain the ideal condition desired.

While the electric toaster, coffee percolator, disc stove, and chafing dish are not used to such a large extent nor for as long a time as the flat-iron, they are used every day in the week, and all form an additional commercial value to the distributer of electrical energy. As stated by Mr. W. H. Radcliffe in the *Electrical Merchandise*, "It is well to remember in this connection that there is no lighting circuit appliance on the market of too small current consumption to be handled and pushed, so long as it can be relied upon to give satisfactory service to the user."

DOMESTIC ELECTRIC RANGES.

The development of the domestic electric range after years of research and practical experience is important from a Central Station man's point of view. The most important conclusions derived from its use are that it provides a greater source of revenue from the idle day circuits than is possible with the smaller appliances, and also that it has a great diversity of load. The data obtained with this appliance varies greatly because of the different conditions experienced, which are important factors in determining the results obtained. These factors include the design used, the style of menu, the number of ranges in operation, the number of persons served, cost of electricity, time of day for heaviest meal, etc. It may prove instructive to refer briefly to some of the data reported from various sources in connection with the cost and operation of electric ranges and the important features of electric cooking in relation to the Central Station.

One of the representative designs now available has 40 per cent. lower operating cost than the type it superseded. Also the connected load has

been reduced from 6 Kw. or more, as in most other ranges, to 3.6 Kw. It was found that representative menus for four or five persons can be prepared at a total monthly cost of $3.00 with electricity at 3 cents per Kw.H. These menus for six successive days are given on pages 114 to 118 inclusive. The maximum demand was 2.85 Kw., and the average daily consumption was 3.281 Kw. The daily load curves are shown on Curve Sheet, page 119. The maximum peak load is approximately two-thirds the connected load. Curve Sheet page 120 is a "Diversity" Curve, which is representative of the resultant or combined maximum demand of using all these menus on the same day. The maximum demand of a range when preparing these representative menus was 2.85 Kw., while with six different ranges in operation the resultant maximum demand was but 9.6 Kw. instead of 17.1 Kw. (6 x 2.85 Kw.), thus showing a diversity factor of 56 per cent. There is considerable variation as to peak demands in different localities. In the larger cities, the dinners may be served as the evening meal, and the breakfast hours would be somewhat later. In all cases, however, the cooking load would supplement the "off peak" load of the Central Station. The peak of the lighting load is usually between seven and nine p.m., although in winter it may occur at about five p.m., due to the overlapping of motor and lighting loads.

MENU NO. 1 FOR AVERAGE FAMILY.

	Amount	Mins.	W.H.	Total W.H.
BREAKFAST:				
Oatmeal	1½ pts.	44	153	
Dropped Eggs on Toast	5 eggs	6	209	
Toast	12 slices	13	133	
Coffee	1 qt.	20	162	
				657
DINNER:				
Pork Chops	8 medium	25	385	
Fried Apples	1¼ lbs.	13	197	
Boiled Potatoes	2 lbs.	77	193	
French Toast	10 half slices	10	171	
Sauce for French Toast	....	7	98	
Coffee	1 qt.	17	175	
				1,219
SUPPER:				
Omelet	5 eggs	10	101	
Fried Potatoes	....	14	248	
Muffins	15	56	723	
Tea	1 qt.	14	266	
Preserves	....	....	....	
				1,338
Total				3,214

MENU NO. 2 FOR AVERAGE FAMILY.

	Amount	Mins.	W.H.	Total W.H.
BREAKFAST:				
Corn Flakes	....	....	....	
Fried Eggs	5 eggs	6	114	
Toast	8 slices	11	112	
Coffee	1 qt.	18	140	
			——	366
DINNER:				
Roast Beef	6 lbs.	135	1,925	
Mashed Potatoes	2 lbs.	68	203	
Baked Macaroni	½ lb.	30	486	
Caramel Pudding	....	20	345	
Coffee	1 qt.	16	126	
			——	3,085
SUPPER:				
Creamed Codfish	....	8	88	
Pop Overs	12	44	764	
Preserves	....	....	....	
Tea	1 qt.	10	178	
			——	1 030
Total				4,481

MENU NO. 3 FOR AVERAGE FAMILY.

	Amount	Mins.	W.H.	Total W.H.
BREAKFAST:				
Oatmeal	1½ pt.	38	192	
Meat on Toast	....	5	90	
Toast	10 slices	15	162	
Coffee	1 qt.	18	137	
			——	581
DINNER:				
Soup	1 qt.	15	180	
Steak, Broiled	3 lbs.	35	607	
Steamed Potatoes	2 lbs.	64	242	
Vegetable Salad	....	....	....	
Suet Pudding	10 individuals	65	191	
Coffee	1 qt.	18	128	
			——	1,348
SUPPER:				
Beef Warmed up	....	6½	96	
Boiled Potatoes	2 lbs.	53	273	
Bread	....	....	....	
Tea	1 qt.	8	139	
Cake	1½ lbs.	54	436	
			——	944
Total				2,873

MENU NO. 4 FOR AVERAGE FAMILY.

BREAKFAST:	Amount	Mins.	W.H.	Total W.H.
Corn Flakes	....	...	....	
Fried Bacon	½ lb.	11	188	
Fried Eggs	5 eggs			
Muffins	....	44	620	
Coffee	1 qt.	18½	140	
DINNER:			——	948
Lamb Chops	10	11	276	
Creamed Potatoes	2 lbs.	12	167	
Green Peas	2 cups	11	71	
Apple Pie	2 pies	60	768	
Coffee	1 qt	18	142	
SUPPER:			——	1,424
Baked Beans	2 cans	30	93	
Toast	10 slices	14½	155	
Sauce	....	....	....	
Tea	1 qt.	12½	212	
Cake	....	...	....	
			——	460
Total				2,832

MENU NO. 5 FOR AVERAGE FAMILY.

BREAKFAST:	Amount	Mins.	W.H.	Total W.H.
Oatmeal	½ pt.	41	189	
Hash	2 lbs.	15	210	
Toast	8 slices	11½	121	
Coffee	3 pts.	23	193	
DINNER:			——	713
Tomato Soup	1 qt.	35	38	
Fried Ham and Eggs	1½ lb. ham, 7 eggs	25	363	
Mashed Potatoes	2 lbs.	80	241	
Turnips	2 lbs.	75	272	
Coffee Jelly	....	....	....	
Coffee	1 qt.	19	157	
SUPPER:			——	1,071
Creamed Beef	½ lb.	14	157	
Fried Potatoes	....	13	225	
Toast	8 slices	13	140	
Tea	1 qt.	11	195	
Layer Cake	....	36	585	
			——	1,302
Total				3,086

MENU NO. 6 FOR AVERAGE FAMILY.

	Amount	Mins.	W.H.	Total W.H.
BREAKFAST:				
Corn Flakes	....	....	....	
Fried Smelts	12 ozs.	19	353	
Toast	8 slices	13	136	
Coffee	1 qt.	18	149	
			——	638
DINNER:				
Boiled Halibut	3½ lbs.	53	726	
Egg Sauce	....	12	178	
Steamed Potatoes	2 lbs.	77	193	
Stewed Tomatoes	1 qt.	67	147	
Pie	....	....	....	
Coffee	1 qt.	18	149	
			——	1,393
SUPPER:				
Scrambled Ham and Eggs	½ lb. ham, 5 eggs	8	136	
Cranberry Sauce	1 qt.	24	297	
Biscuits	1 pan	35	600	
Tea	1 qt.	10	159	
Layer Cake	....	....	....	
			——	1,192
Total				3,223

A heavier class of menu was also used which was heavier than those used by the ordinary family, as a roast was included in five of the daily menus. The dinners were extra large, and were served to ten or twelve persons. The suppers were lighter as they included cold meats, which were thus available. A representative menu, with wattage consumption which approximates the daily average demand of this class, is shown on this page.

HEAVY DEMAND MENU—NO. 1.

	Amount	Mins.	W.H.	Total W.H.
BREAKFAST:				
Pork Chops	1 lb. 2 ozs.	21	355	
French Toast	6 slices	5	86	
Coffee	3 pts.	22	169	
			——	610
DINNER:				
Roast Turkey	10¼ lbs.	156	2,388	
Cranberry Sauce	1 qt.	25	420	
Potatoes	3 lbs.	84	206	
Onions	2 lbs.	85	223	
Suet Pudding	15 ozs.	36	611	
Water	1 qt.	10	171	
			——	4,019

SUPPER:				
Cold Roast Turkey...........	....	....	....	
Biscuits.....................	....	44	582	
Tea.........................	1 qt.	10	159	
Cranberry Sauce..............	....	....	....	
Pork Cake...................	....	....	....	
			——	741
Total..				5,370

The K.W.H. consumption and the maximum load from both classes of menus per day were as follows:

	Heavy Demand Menu		Av. Demand Menu	
	K.W.H.	Max. Load	K.W.H.	Max. Load
1st day....................	5.145	2.000	3.214	2.500
2nd day....................	5.296	2.200	4.481	2.200
3rd day....................	5.302	2.400	2.873	2.850
4th day....................	6.302	2.200	2.832	2.450
5th day....................	5.156	2.100	3.086	2.050
6th day....................	5.370	2.000	3.203	2.050
Average K.W.H. per day..	5.540		3.281	

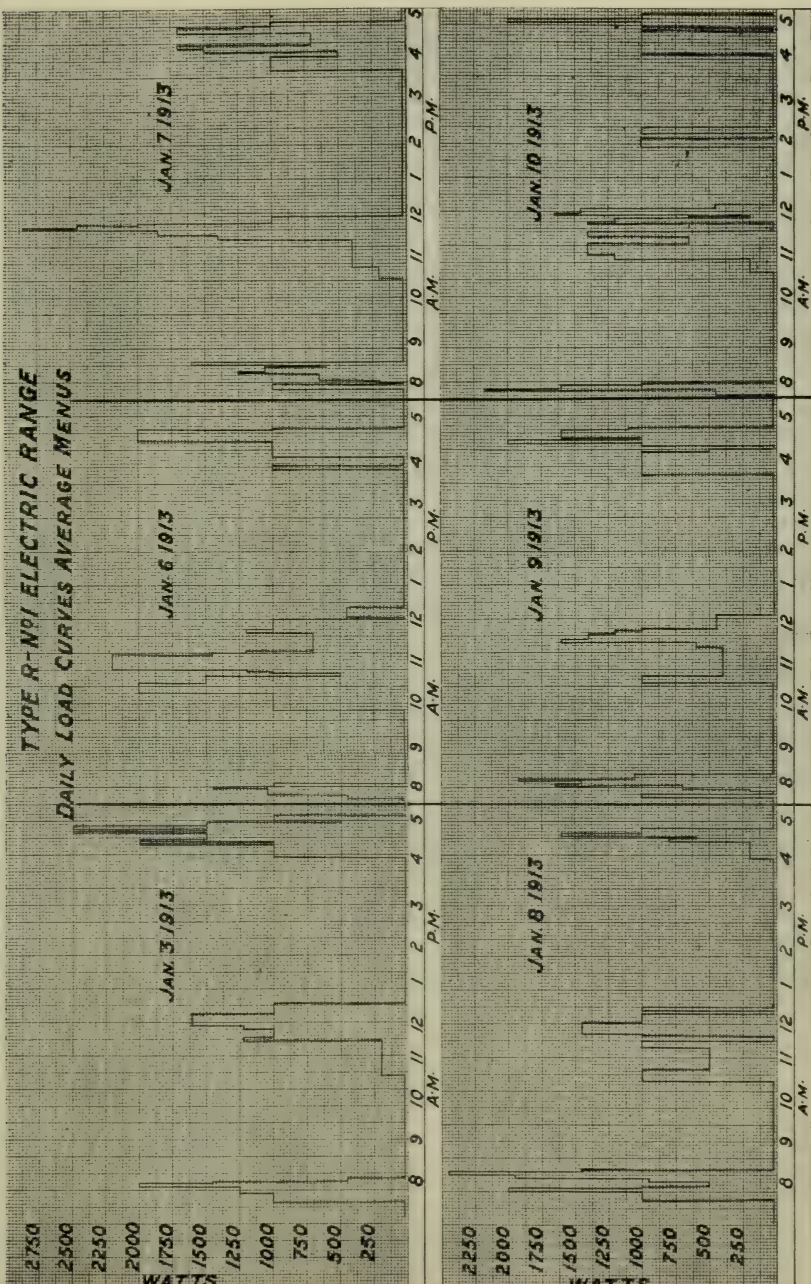
The energy consumption will, therefore, probably be between 5.540 K.W.H. and 3.281 K.W.H., with corresponding costs per month as follows:

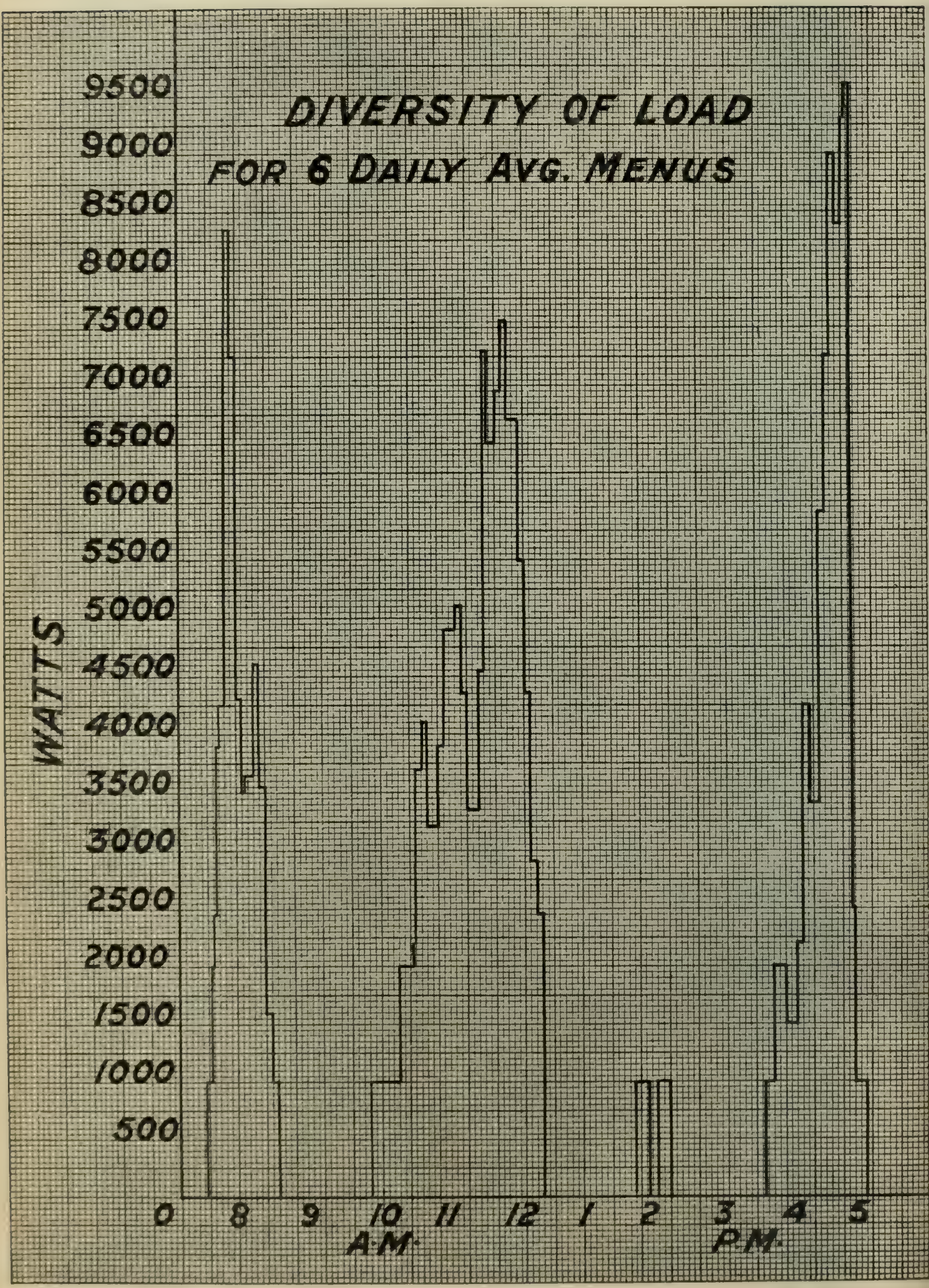
	K.W.H.	Cost at 3 Cents K.W.H.	Cost at 5 Cents K.W.H.
Minimum..........................	3.3	$2.97	$4.95
Average..........................	4.5	4.05	6.75
Maximum..........................	5.6	5.04	8.40

The operating cost with minimum consumption is approximately $3 per month with a Three Cent rate, and $5 per month with a Five Cent rate. The amount of energy used would, of course, vary with each family, and would be at a minimum when used by an experienced operator. For instance, a device such as the oven may be used to bake several articles in succession, thus saving the delay and expense of re-heating. Practically all the water used with the above menus was heated in a cast aluminum tea kettle, on one of the stoves, and is included in the total energy consumed. These tests show that excellent results can be obtained at a reasonable expense by the use of an electric range.

The comparative cost of cooking various articles on the electric range and gas range with electricity at $.03 per K.W.H. and gas at $1 per M. is shown below.

		Electric Range			Gas Range		
Article	Quantity	Mins.	W.H.	Cost	Mins.	Cu.Ft.	Cost
Water...............	4 qts.	26	448	$.013	15	4.5	$.005
Roast Beef...........	4 lbs.	109	1311	.039	70	38.5	.039
Steamed Potatoes.....	2 lbs.	87	180	.005	45	4.8	.005


TYPE R-No1 ELECTRIC RANGE
DAILY LOAD CURVES AVERAGE MENUS
JAN. 3 1913
JAN. 6 1913
JAN. 7 1913
JAN. 8 1913
JAN. 9 1913
JAN. 10 1913
WATTS
2750 2500 2250 2000 1750 1500 1250 1000 750 500 250
2250 2000 1750 1500 1250 1000 750 500 250
8 9 10 11 12 1 2 3 4 5
A.M.
P.M.


DIVERSITY OF LOAD
FOR 6 DAILY AVG. MENUS
WATTS
9500
9000
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
8
9
10
11
12
1
2
3
4
5
A.M.
P.M.

ARTICLE	QUANTITY	Electric Range MINS.	W.H.	COST	Gas Range MINS.	CU.FT.	COST
Steamed Onions.......	1 lb. 9 oz.	145	382	$.011	65	11.5	$.012
Broiled Steak.........	2 lbs.	25	423	.013			
Bread...	Capacity of oven	77	1087	.033	55	27.3	.027
Apple Pies............	2	60	768	.023	70	29.7	.030
Custard Pies..........	2	58	919	.028			
Boiled Chicken.......	3 lbs.	96	636	.019	101	14.2	.014

The average number of K.W.H. per person per meal were .219 for the representative menus, and .369 for the heavy demand menus. These were on the basis of 5 persons served.

Daily cooking records for one week on the same range but with different menus each for five or more persons are shown on page 122. This is equivalent to .239 K.W.H. per person per meal. Tests on the range indicate that it has lower current consumption, takes less time to cook, and the maximum demand is slightly higher than any of its three most popular competitors. A similar record, page 123, made by the Heating Committee, Edison Illuminating Company, in 1907, with lighter menus, and obtained from a range made by a different manufacturer, shows an expenditure of .631 K.W.H. per person per meal, or a cost, at Three Cents per K.W.H., of $.01893 per person. This latter comparison will serve to show the advancement made by the manufacturers in the art of range making during the last few years.

These results show a cost varying from $.007 to $.019 per person per meal with electricity at Three Cents per K.W.H.

Another report regarding the cost of cooking with a range of different capacity, but of the same manufacture as the device last referred to, gives an average of $.008 per person per meal for breakfasts, and $.013 for dinners, at the same rate. The maximum demand varied from .5 to 2.8 Kw. Another record gives $.008 as the average cost per person per meal. Returns from an electric cooking campaign conducted by the Nashville Electric Light Co., show that 18 electric ranges were added to the Central Station's lines. Most of these were of the domestic type, which earn average monthly incomes of $3.30 each at Three Cents per K.W.H.

The amount of revenue received through the sale of electric energy for cooking, as compared with that expended for lighting, from the same customers, is also interesting. In one instance, where records were kept for a period of 10 months, there was a weekly average of 68.2 K.W.H. required for cooking, and but 4.6 K.W.H. for lighting. Another installation consumed only 287 K.W.H. for lighting, and 2,441 K.W.H. for cooking, for a period of one year. In this case the annual gross receipts were $20.95 for lighting, as compared with $73.23 for cooking at a Three Cent net rate. The connected load for lighting was 1,000 watts. That for heating and cooking was 5,150 watts, but the maximum demand never exceeded 2,225 watts.

While these results are selected at random, and vary greatly because of existing conditions, they serve to indicate the future commercial possibilities awaiting Central Station development.

DAILY ELECTRIC COOKING RECORD FOR SEVEN DAYS

Each Meal is sufficient for Five or more Persons

	Breakfast	Food	Dinner	Food	Supper	Food
	KW.H.		KW.H.		KW.H.	
Mon.	.657	Oatmeal, Dropped Eggs on Toast, Toast, Coffee	1.219	Pork Chops, Fried Apples, Boiled Potatoes, French Toast, Sauce for French Toast, Coffee	1.338	Omelet, Fried Potatoes, Muffins, Tea, Preserves
Tues.	.366	Corn Flakes, Fried Eggs, Toast, Coffee	3.085	Roast Beef, Mashed Potatoes, Baked Macaroni, Caramel Pudding	1.030	Creamed Codfish, Pop Overs, Preserves, Tea
Wed.	.581	Oatmeal, Meat on Toast, Toast, Coffee	1.348	Soup, Steak Broiled, Steamed Potatoes, Vegetable Salad, Suet Pudding, Coffee	.934	Beef Warmed Up, Boiled Potatoes, Bread, Tea, Cake
Thurs.	.948	Corn Flakes, Fried Bacon, Fried Eggs Muffins, Coffee	1.424	Lamb Chops, Creamed Potatoes, Green Peas. Apple Pie, Coffee	.460	Baked Beans, Toast, Sauce, Tea, Cake
Friday	.713	Oatmeal, Hash, Toast, Coffee	1.071	Tomato Soup, Fried Ham and Eggs, Mashed Potatoes, Turnips, Coffee Jelly, Coffee	1.302	Creamed Beef, Fried Potatoes, Toast, Tea, Layer Cake
Sat.	.618	Cornflakes, Fried Smelts, Toast, Coffee	1.393	Boiled Halibut, Egg Sauce, Steamed Potatoes, Stewed Tomatoes, Pie, Coffee	1.192	Scrambled Ham and Eggs, Cranberry Sauce, Biscuits, Tea, Layer Cake
Sun.	.610	Pork Chops, French Toast, Coffee	4.019	Roast Turkey, Cranberry Sauce, Potatoes, Onions, Suet Pudding	.741	Cold Roast Turkey, Biscuits, Tea, Cranberry Sauce, Pork Cake
	4.493		13.559		6.997	

Total K.W. Hours for seven days 25.049

DAILY ELECTRIC COOKING RECORD FOR ONE WEEK

(Report of Heating Committee, Edison Electric Illuminating Companies, June, 1907)

	Breakfast	Persons Served	Food	Lunch	Persons Served	Food	Dinner	Persons Served	Food	Special Baking	Ironing
	KW.H.			KW.H.			KW.H.			KW.H.	KW.H.
Mon.	1.9	5	Cereal, Toast, Coffee, Boiled Eggs	1.9	4	Warmed-over Dishes, Tea, Toast	1.4	3	Broiled Steak, Tea, Boiled Potatoes		
Tues.	2.8	5	Cereal, Coffee, Poached Eggs, Toast	1.5	4	Omelette, Tea	3.5	5	Roast Mutton, Asparagus, Potatoes, Beets		2.9
Wed.	2.8	5	Cereal, Coffee, Griddle Cakes	.6	4	Stew, Tea	4.9	3	Chops, Peas, Tea, Potatoes, Custard		
Thurs.	1.5	5	Cereal, Coffee, Toast, Boiled Eggs	1.6	3	Eggs, Tea, Toast	6.1	5	Roast Veal, Corn, Spinach, Potatoes		
Fri.	2.5	5	Cereal, Coffee, Griddle Cakes	2.0	4	Stew, Tea, Poached Eggs	3.7	5	Soup, Fried Fish, Tomatoes, Spinach, Potatoes, Pudding	4.2	
Sat.	2.6	5	Cereal, Coffee, Stew, Toast	.5	4	Warmed-over Soup, Tea	3.5	4	Steak, Potatoes, Corn, Baked Apples		
Sun.	3.1	5	Cereal, Coffee, Toast, Eggs	5.0	4	Roast Beef, Potatoes, String Beans, Soup, Ice Cream	.5	5	Cake (Baked Saturday), Salad, Tea		
	17.2	35		13.1	27		23.6	30		4.2	2.9

EQUIPMENT USED

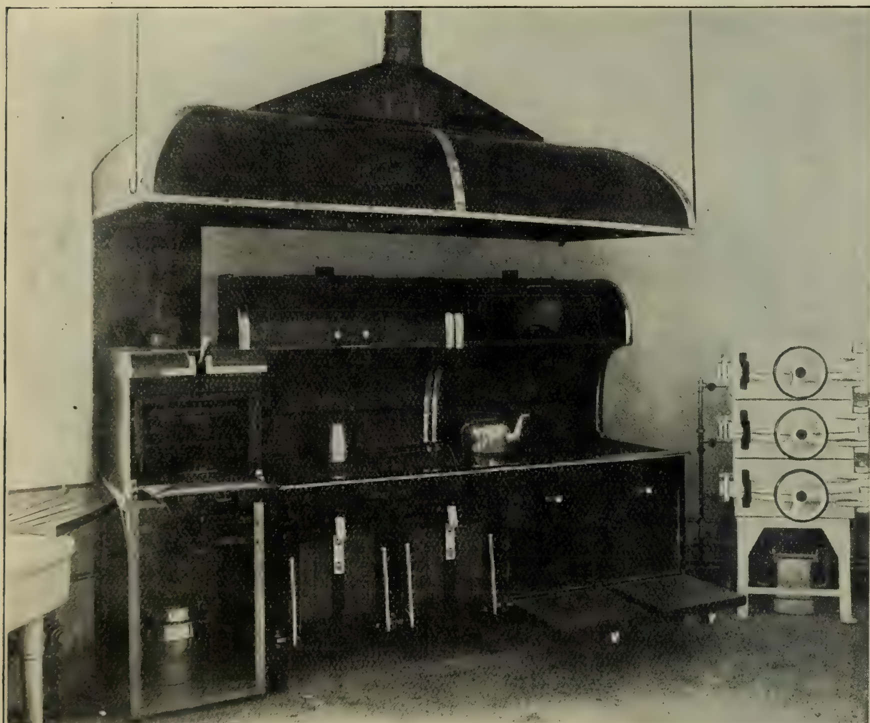
Range consisting of		
Two 8-in. Stoves	consuming	1,625 Watts
One 6-in. Stove	"	440 "
One 9 x 12-in. Broiler	"	1,300 "
One Oven	"	1,500 "
Also one Plate Warmer (12 x 14 x 20-in.)	consuming	300 "
Total		5,165 Watts

CONSUMPTION DATA

Total Cooking Consumption	51.8 KW.H.
Watts per Person per Meal	631.0 KW.H.
Number of Meals Served	92
Average number of Persons per Meal	4.4
Lighting Consumption	5.63 KW.H.
Milk Warmer	1.63 KW.H.
Ironing	2.9 KW.H.

HOTELS, RESTAURANTS AND PUBLIC INSTITUTIONS.

It is natural that the successful development and use of electric heating devices for domestic purposes should be followed by installations of larger capacity for hotels, restaurants, hospitals, on board ships, etc.



Electric Cooking Equipment in King George Hospital, Winnipeg

Recently the King George Hospital, Winnipeg, installed an electric cooking equipment, consisting of two hotel type electric range units and one broiler unit, which has sufficient capacity to cook for 250 persons. Each range section comprises two roasting ovens, and a top cooking surface divided into eight rectangular hot plates, with switch gear, etc., necessary for control. The broiler installed with this range has an active broiling area of 14 in. by 20 in., or 280 sq. in., and is sufficient for broiling at one time about twelve pounds of chops having a thickness of 1½ inches. With an average weight per steak of two pounds, five or six steaks may be broiled at one time, or about thirty-six steaks, or seventy pounds, of meat may be

broiled per hour. I have been unable to get all the details with respect to the operation of this range, the only information obtainable up to date being the record for one month, namely, April 5th to May 5th, wherein one range section consumed 1,545 K.W.H., and the other consumed 1,199 K.W.H., making a total of 2,744 K.W.H. for the month. During this period 14,500 meals were served, and on this basis the average current consumption is 184 watts per meal, which, at the rate of 3 cents per K.W.H., amounts to .567 cents per meal served.

The London Homes Delicacies Association supplies meals for over 5,000 persons per day. Mr. Clinch, the Manager, is quoted as follows:—

> "The actual cost of electricity used in practice, and we have now had six months' steady working, proves to be lower than our estimate even at the price of 2 cents per K.W.H., and we are satisfied that it would not be possible to work this kitchen, taking all things into consideration, at a less cost by using coal or gas as the heating agent."

This installation has also proved very durable and reliable.

A report from one of the restaurants which is conducted by a large manufacturing company for the benefit of its employees, shows that it furnishes approximately 275 meals per day at a cost of less than 1 cent per meal for cooking with electricity at 2 cents per K.W.H.

A few months ago a prominent Club in Boston was considering the question of adopting electric cooking apparatus in its restaurant, and investigation was made in Boston to ascertain the cost of cooking with various fuels, and with electricity. Briefly, the data obtained was as follows:—

A Club kitchen using an electric range and bake oven, and having steam heated stock kettles and serving table, which has been in operation for several months, showed that electricity at \$.03 per K.W.H. would compete with coal at \$7.50 per ton, or with gas at \$1 per thousand feet.

The lowest cost per person per meal was reported by a Club doing all cooking on a coal range, the figures being \$.007. The highest cost was in a Club using coal, charcoal, and gas, the figure being \$.017. Two other Clubs gave \$.0112 and \$.0101 respectively.

The most representative apparatus for such purpose includes the hotel range, broiler, bake ovens, and toasters. Hotel ranges are now available which are capable of supplying 100 or more persons. These are equipped with two roasting ovens, and a top cooking surface with eight rectangular hot plates. This appliance has a maximum rating of 19.2 Kw., with a probable maximum demand of 14 Kw. The Hotel Broiler, with which it is possible to produce about 70 lbs. of steak per hour, has a rated wattage of 5 Kw. About 500 watts are used to keep the broiler hot for immediate use. An interesting feature has been noted in connection with the use of an electric grill in a London restaurant. All of the fat which drips from the meat is collected in a pan underneath, and it has been found that this fat, which is wasted in ordinary forms of cooking, can be sold at a price which more than pays for all the electric energy used for cooking.

Large electric bake ovens are available with the following specifications:

Width	40″	50″	50″
Depth	25½″	25½″	35½″
Height	48″	56″	56″
Shelves	3	4	4
Cap. in 1½ lb. Loaves	30	56	84
Loaves per Hour	42	70	100
Max. K.W.	6	9	13

Commercial bakeries can use these ovens to advantage as an auxiliary equipment for pies, pastry, etc. Power companies can afford to give extremely low rates between midnight and 5 a.m., during which time the bakeries generally do most of their baking.

The electric toaster is also used extensively by hotels and restaurants. Toasting in such places makes heavy but intermittent demands on the kitchen. Guests usually want their toast in a hurry, and it must be served fresh, so that a device with high temperature is necessary for quick service. One of these appliances will toast two, three, or six slices of bread simultaneously in one minute. It consumes 1350-1800-3150 watts respectively. Other miscellaneous devices, such as stock kettles, coffee and water urns, steam tables, etc., are also available to improve idle circuits.

MARINE EQUIPMENT.

The devices above referred to are especially adapted for use on ship board, because of their many advantages. In the spring of 1910 the U.S. Navy Department made a thorough investigation of electric cooking and baking, with the result that the use of such appliances was strongly recommended for installation on board naval vessels. The electric range was found cheaper than coal, and productive of better results. It required 1 hour, 40 minutes, to roast 10 lbs. of beef at a cost of $.05 with the electric range, as compared to 2 hours, 20 minutes, with costs of $.114 for anthracite coal and $.065 for bituminous coal, in the coal burning range. With the latter it required 2 hours, 25 minutes to attain cooking temperature, and but 50 minutes with the electric range.

Further detailed information regarding these devices is given in Mr. H. J. Mauger's paper, "Future of Electric Heating and Cooking in Marine Service," in the May, 1914, Proceedings of the A.I.E.E. An interesting account, entitled "Electric Cooking on the Battleship *Texas*," is given in the *Electrical World* issue of May 16th, 1914.

INDUSTRIAL APPLICATIONS.

The advantages and almost unlimited possibilities of electrically heated industrial applications afford additional desirable opportunities for the Central Station. Rapid progress is being made in introducing electric heaters into all branches of industry where other sources of heat have been found inferior, and even dangerous in some cases. Many industrial concerns would find it convenient and economical to replace gas

or steam by electricity for the production of light, heat, and power, but are often prevented from so doing because of the need of heating a few special appliances. With suitable electrically heated devices available, it is thus often possible to install a complete electrical equipment throughout.

It is stated that the heating load on the mains of the New York Edison Company increased from 200 Kw. in 1900, to 3,000 Kw. in 1913. The larger installations of irons in clothing establishments and tailors' shops produce from $500 to $1,500 revenue yearly. Large-sized tailors' irons are now in extensive use with maximum wattages of 750-900 watts.

The circulation water heater with 600, 1,000, 2,000 or 3,000 watt units, forms a steady load which is ordinarily continued for some time, and can be used during periods of least demand.

Glue pots with wattages ranging from 20 to 1,100 watts, can be introduced into numerous industries to provide a steady continuous load between the periods when cooking requirements are greatest.

Electric soldering irons are being used extensively and provide incomes from 75 to 275 watts.

The electric beer vat drier furnishes a seasonable load of 3 Kw. This is utilized by brewers during the Fall months, for drying out casks and vats before varnishing.

Oil tempering baths afford a means of drawing and hardening tools whereby uniform and successful results are always obtained. These appliances are made in three sizes with maximum wattages of 6, 7.2, and 26 Kw. respectively.

Metal melting pots for lead, tin, solder, babbitt metal, and similar alloys vary in energy consumption from 2.1 Kw. to 30 Kw., and have capacities ranging from 30 to 2,960 lbs. of lead.

Electric ovens of all sizes and for a variety of drying and baking processes also contribute towards providing a load worthy the careful consideration of all Central Station managers.

DISCUSSION.

The President: Is there any discussion or any question you would like to ask upon this paper?

A Delegate: Is there anything in the assertion that there is less shrinkage in, say, a 5-lb. roast cooked by electricity than there is when cooked in the ordinary stove?

Mr. Brown: I have heard statements that quite a saving in cooking operations can be made by means of using an electric range. We have never made any experiments along that line. It seems reasonable that there should be a slight saving, but I think it would be only slight.

Mr. Moore: The Simplex Company conducted some tests on that subject about a year and a half ago. While they found that the average shrinkage on a roast in an electric oven ran a little above 8%, on a coal or gas oven it sometimes ran as high as 20% to 22%. In other words, the difference was not as great as claimed, but still it was appreciable. With a fowl it was considerably greater, the shrinkage being from 5 to 7% in an electric oven, and as high as 25% with coal or gas. The reason given was that in an elec-

tric oven the pores of the meat were quickly sealed by the high heat, and the juices could not escape so readily, being retained in the meat. By the same reason the electric ovens were practically self basting, any evaporated juices being kept in the oven instead of escaping through a flue, as is common with a coal or gas range.

Mr. D. H. McDougall: I want to thank Mr. Brown for his admirable paper. It is a very interesting subject to Central Stations, and his paper gives rise to some questions in the mind of the Central Station man as to the effect of the universal use of electric ranges. That is a subject we have always been more or less timid about, as, of course, what we are more interested in developing is the off-peak load. Take for instance, in Toronto, where we have 17,000 residential customers of our own, outside of the Hydro customers. With an added load of 2 kilowatts per customer the cooking load would practically form a peak of its own, probably bigger than our normal peak, and it would introduce a problem requiring a re-arranging of our existing capital investment that would require considerable study. I think that now that the Ontario companies have been largely relieved of the street lighting peak they can encourage electric cooking to a certain extent, but if we are going to form another peak higher than our normal peak by the use of ranges, it may be necessary to revise our rates. Our rates at the present time consist of primary and secondary rates, whereby the cooking load would come on approximately a 3-cent rate. That, if it came on the peak, would not be adequate remuneration for the service required of the Central Station companies, if they have to make additional investments in plant. That is a point that I think should be more fully discussed.

The next thing I noted was Mr. Brown's mention, in a brief way, of the circulation of water heaters. I think that it would be very useful if we would get some more information on that subject. It is only touched on here. I would like to know what is the rate of efficiency and how the electric water heater for house circulation can compare in efficiency and cost with the gas heater,such as the Rudd or any other instantaneous heater.

Mr. A. A. Dion: Mr. Chairman, Mr. McDougall has given voice to what was in my mind, principally, with regard to this subject. I have not had time to read this paper before. I merely glanced at it. But that is the point that has been in my mind in connection with the use of electric ranges: Whether we can afford to carry these on our peak load at the low prices that will be necessary to get the business. Take our city, for instance, where the Hydro-Electric Commission control the rates, where they have a system of area charge of so much a month, and a consumption charge which, when the cash discount is taken off, amounts to 2 cents. It has been proposed by our competitors that they should endeavor to introduce electric ranges throughout the city and that at this cheap rate they should be able to do it. Now, the theory of the rate is that the customer having paid his flat area charge we can afford to encourage the use by him of all sorts of electrical appliances at a very low meter rate because we are protected as to our investments by the flat charge. But this theory holds good only, it seems to me, with regard to these electrical appliances which are prin-

cipally off-peak loads like most appliances, and I quite agree with the theory in so far as they are concerned. But it seems to me that the electric range is in a good deal different class in our latitude and with the customs of our people in regard to meals. It seems to me that the electric range will be a peak load as far as the evening meal is concerned, and that a very large number of ranges added to our circuits would mean a large peak load to be taken care of, and I figured out that at the price which our competitors are paying for their power—they are buying their power on a volt-ampere basis—the more electric ranges they took on at the prevailing rates, assuming that all those ranges would be all pretty near fully occupied at the time of the evening meal, the more money they would lose. That is the way it struck me. The diversity factor will come in to effect this result, but to what extent I don't know. I think as Mr. McDougall does that it is a serious question for Central Stations, considering the investment, whether there is any money in selling current for electric ranges at a very low rate.

A Delegate: Does Mr. Dion infer that they are losing money any way?

Mr. Dion: They have not started, but I think they are going to.

Mr. G. Ratcliffe Hulme: I feel quite at one with the speakers who preceded me in so far as if the electric range load is going to be superimposed on our present peak load then the ranges are not going to be a profitable source of revenue to us, and from that point of view should not be unduly encouraged.

I would like to make one or two comments on some of the statistics Mr. Brown has been good enough to furnish us with as to revenue from various sources. I find in the first place that he gives us a revenue of 70 cents per month per electric flat-iron installed. That seems to me to be a very large revenue, and I am just afraid there is some mistake. If there is not a mistake, I can only assume the town where that revenue is derived from is not, at any rate, a home town of militant suffragettes, nor is it a paradise of Chinese laundrymen. But wherever the town is, we can only say more power to the elbow of the ladies who are using these irons! It has always appeared to me that the flat-iron connection is, in its way, the best connection the Central Station can have, because, by the nature of things, it cannot superimpose itself on the peak load. The difficulty, largely, is that unless the consumer has other appliances, it is necessary for the flat-iron to be connected to the ordinary lighting circuit, and consequently current has to be paid for at lighting prices, because, obviously, it will not pay the consumer to go to the expense of a separate circuit, nor will it pay the Central Station to go to the expense of installing a separate meter for one flat-iron, even if it does give the tremendously high revenue of 70 cents a month. I was speaking to-day with a colleague of mine, a director of several power companies and also a director of a fire insurance company, and he said—and I was rather struck by his remark—he said, "As a power man I must cultivate the use of flat-irons. As an insurance man I must try and get them discarded,because we had two fires in this city only yesterday, arising from the use of flat-irons." If we find that feeling is going to be prevalent among fire insurance companies, I think it is incumbent on us to take some steps to counteract it. Fires can only be caused by neg-

ligence. We should issue a particular warning that current should be always turned off when the iron is left on the ironing board or table.

Returning to the subject of electric ranges, I cannot quite accept the suggestion conveyed by this paper that electric ranges are more profitable to Central Stations than any other form of demand. On page 12 of the paper, it is stated that a revenue of $20.95 was derived from a lighting installation with a connected load of 1,000 watts, and that a revenue of $73.20 was derived from an electric range connection with a maximum demand of 2,225 watts. From my calculations—I may be wrong—the lighting revenue was practically $63 per KW. demand—taking the demand at the usual 33⅓% of connected load—whereas the range revenue was only $33 per KW. of maximum demand. It seems to me, if the cooking range load comes on top of our lighting load, a revenue of $33 per KW. is not sufficient for us. I do not think under normal conditions, taking the normal Central Station, particularly those stations operated by steam power, any station can afford to sell electrical energy, whatever it is used for, at peak load under $40 per KW. year. So that, if we will look at it from a purely financial standpoint, the connection of ranges is not going to help us materially altogether, and it may be—I think it would be—good policy to offer all the encouragement we can to the use of heating devices of every description, including ranges. In those districts where the people have their principal meal at mid-day, a load of that kind will help us very materially, but in those districts where the people have their principal meal in the evening, the cooking operations incident to that meal coming along just at the time of our lighting load, make it appear that that district is not a suitable field for the exploitation of electric ranges—that is, if we are going to make any money from the supply of electrical energy to them. But the question, after all, is as much one of policy as of finance—policy in regard to the encouragement of all forms of heating devices—a policy which I favor, and I should be very glad indeed to have the views of the gentlemen here on the question generally.

I am from the other side of the water, and connected with a large number of power companies, and I am sure my colleagues on the other side will be very happy indeed to hear from me what the views of our friends on this side are on this very important subject of the value of heating devices to Central Stations.

The Vice-President: Would it not be better to look at the question in this way: Is it not better to adjust our rates in order to get the business rather than to discourage the business. I wonder if we could not hear from Mr. Bird of the Kaministiquia Power Company on this subject.

Mr. W. L. Bird: We are not directly interested in the sale of current or appliances to consumers; we are indirectly interested in the wholesale sale of electric power. If they are able to build up their load, it is not going to injure us at all. I think, like Mr. Mudge, that we should possibly encourage the use of electricity and adjust the rates. The important factor is the diversity factor. The lighting load is very poor, taking the whole 24 hours, and if we can build up the average use of electricity by the household and encourage it in every form, we will very materially im-

prove the diversity factor, and, therefore, the differential in rate will tend to equalize itself and help save the situation. Take in the case of Ontario, where the Hydro are endeavoring to secure the interest of every householder—or rather every voter (hear, hear)—the Central Stations have got to do something to meet the demand of the public and, therefore, I do not think the Central Stations can afford to discourage electric cooking. They have got to overcome the difficulty and stand up with the public.

Mr. A. A. Dion: Supplementing what I said a while ago and what you have just stated, I would like to say that I do not consider it is necessary for Central Station companies to make a lot of money out of electric ranges. If they can adjust their rates so as to cover their cost they are doing a good thing, because the use of the electric range in the house will lead to the use of all sorts of appliances. It is going to be a very powerful agent in causing the householder to do everything electrically, and viewing it in that way, we probably can afford to carry electric ranges at cost.

Mr. Gilman: To my mind, it does not seem so much a matter of selling energy for electric cooking at a cheap rate as to be able to sell a stove at a moderate cost. Of the many stoves and ranges on the market at the present time, I would venture to say 90 per cent. belong to the Peerless or Packard class, rather than to the Ford class. If we were able to sell stoves for from $30 to $40, we would naturally have considerably more of them on our lines than at present. I have found our customers willing to pay from $3.50 to $5 per month for electric cooking, which figures at our rates are about the average for families of from three to five persons.

Mr. H. S. Brown: I think Mr. Hulme took my figures in the paper as the connected load rather than the maximum demand load. I think the maximum demand is the proper basis to figure on. That would make quite a difference. I am assuming here that lighting and heating rates will be the same, which, I think, is pretty general in Ontario at least. And these figures here show that a maximum demand for heating of two and a quarter times of maximum demand for lighting gives a revenue of near four times; therefore, if your lighting load is a profitable one, your heat load must be an exceedingly profitable one.

Mr. J. C. Wills: There is another feature in regard to the electric range: it is used considerably more in the summer than in the winter. In winter in residences they will frequently discontinue the use of the range and use the coal stove.

Mr. H. S. Brown: The modern range is built more or less on the fireless cooker principle, and in the winter months the oven would probably be shut off at 5.30 when the dinner was going to be served at 6.00 or 6.15 p.m. Now, the maximum of the range will come before 5.30 p.m. and the lighting load peak usually does not come until after that peak will be over.

Mr. D. H. McDougall: I do not know of very many households that will have their evening meal at 6.15 p.m. It is just that very point that makes Central Stations a little dubious of results. My opinion is, the peak is liable to come on about 6 o'clock and, as a matter of fact, the winter

peak of a Central Station is between 5 and 6 o'clock, so that I think Mr. Brown's point is not very well taken.

A DELEGATE: I would like to call attention to one installation I know of ranges. Their total connected load is 3,000 KW. and they have never noticed that load except between 11 and 12 o'clock in the daytime, and never noticed more than 100 KW. loss, making 31 diversity factor.

MR. BROWN: Is that in a large city or small town?

A DELEGATE: In a city of 12,000.

MR. BROWN: Dinners will be served in the middle of the day in that city.

A DELEGATE: They have simply gone after it and catered to the working class of people a good deal. They buy their ranges in large lots to get a low price, and put them out on the monthly payment plan. As a matter of fact, they only charge $12 as an initial payment on ranges, and $1 per month after, and they figure the income they get out of them pays for the difference in the cost of the ranges. Their average bill has been $2.50 a month, giving them an income of $30 a year for a range. They have a 3-cent rate.

A DELEGATE: It was a particularly interesting paper, and I think on a 50 per cent. basis of present price for cooking, we would have no difficulty in finding a market for the different ranges if the first cost will get down. You can buy the best coal stove anywhere from $45 to $50, and what is there about an electric range to cost from $100 to $125? That is the main thing that keeps the people from taking any interest in it. That is my experience in the small town I am in. If they were only a trifle higher than a coal stove a person could find a market, but at the present time they are 50 per cent. higher than coal stoves.

MR. HIGMAN: As an enthusiastic user of electricity, I should be very sorry indeed if any feature or phase of the sale of electrical energy should prevent the free use of ranges and other domestic articles. We must all admit, I think—those of us at any rate who have made a trial—that there is no apparatus at all comparable to the electrical apparatus. It is utterly impossible to turn out as good work with coal, wood or gas ranges as you can do with the electric range. I have tested it out in all its phases and can speak from experience in that respect.

With regard to the question raised by Mr. McDougall a minute ago as to water heaters, a friend of mine installed one of the Simplex heaters connected with his range boiler recently, and is paying for the energy under the lighting rate, which is a fixed rate of 4 cents per 100 sq. feet of space and 2.2 cents per KW.H., and he finds no difference as to the cost as between this electric heater and the gas heater which it superseded. Using the high heat in this heater, he is enabled to draw off water into the bath immediately at 120 degrees Fahr., which is quite warm enough for bathing. If economically used, I think the circulating water heater is a very first-rate appliance.

THE VICE-PRESIDENT: I can certainly endorse what you said about better quality; I have had an electric water range in my house for the last six months and it certainly is a very much better appliance.

If there is no further discussion we will proceed.

MR. WILLS MACLACHLAN: As we have a couple of representatives of the manufacturers, might I ask one question? It has been asked a couple of times. Is there any relief in the near future for the lowering of the cost of the electric range? That is, can it be made even cheaper, even if a little is lost in the efficiency, to get the smaller householder to use it? We have used in some of our towns, in one town particularly, a cheaper and possibly less efficient type of range, and it has gone very well. It is a home-made affair, and I would suggest that this matter be referred to the Commercial Committee for a report and very serious consideration during the coming year.

THE VICE-PRESIDENT: Perhaps we might have a few words from Mr. Moore and any other representatives of the manufacturers before we close the discussion.

A DELEGATE: I would like to say that the matter of price of electric ranges is simply a matter of output. That is what makes the price so high now, and if it were taken up more generally by the Central Station men and gone after harder so as to increase the output, the price would very naturally come down. That is purely and simply what holds it up.

THE VICE-PRESIDENT: Suppose the price was brought down, it would probably increase the output.

MR. BROWN: The cost of an electric range is always going to be higher than the gas range. It is inherently a more expensive piece of apparatus to build. We find an efficient range or one sufficient to meet conditions must be lagged and practically every part in it must be lagged, the oven particularly. The heat elements alone are composed of several parts, any one of which costs more than a gas burner. Now, it is true that the cost of the range is comparatively high at the present day. As the last speaker mentioned, this will naturally come down as the quantity increases, but it will be a long time before we will be selling an electric range at the price of a gas range.

One point was raised by Mr. McDougall in regard to circulating water heaters. We have no definite data to offer at the present time.

MR. G. W. MAGALHAES: Before we leave this subject, I would like to make a suggestion which may obviate the necessity of having to re-adjust rates. The point has been brought up that the universal use of heating and cooking appliances might change the Central Stations' "peak" from a lighting to a heating "peak." I understand that there are available on the market two-rate meters, with two registration dials; the moving element of the meter is shifted from one dial to the other by means of a maximum demand device. Knowing the maximum demand of any installation, the demand device can be set for that demand, and whenever that demand is reached the meter will be shifted over on to one of the dials; all of the consumption on this dial can be billed at a rate which will allow for the investment charges necessitated by the service in question.

THE VICE-PRESIDENT: We are to have the pleasure of listening to Mr. J. M. Wakeman, of the Electrical Development Society, to-day. If Mr. Wakeman is in the room we would be very glad to hear from him now.

MR. J. M. WAKEMAN: Mr. President, members of the Canadian Electrical Association, fellow-members of the National Electric Light Association, and my fellow-members over here from the Society for Electrical Development, brother Britishers, I think I have covered you all—It is a great pleasure as well as a great opportunity to come before you this morning to tell you something about the Society for Electrical Development. Yesterday in listening to your President's address I was particularly interested to note the stress which he laid upon the necessity for co-operation. We have come within the last few years to recognize the fact that co-operation is the only successful banner under which we can fight our business battles. For a good many generations the world indulged practically entirely in the business of war. It was a very ruinous, very costly—in fact, the keenest kind of competition. And after we had passed from the age of war to the age of business we unfortunately brought the same keen competition, wasteful methods, into our business warfare, and within the last few years we have come to recognize the fact that in order to develop an industry and in order to get the most out of it for ourselves even it is necessary to co-operate, not only with those who are engaged in business with you but also with your competitors and with the general public whom you serve. In the final analysis the man who will make the greatest business success in the future will be the man who best knows how to co-operate.

The Society for Electrical Development was founded in New York about a year and a half ago by a body of practical men, all of them men of good sound business sense; all of them men successful in their own business careers. I am mentioning that because there was at one time a feeling that the Society's plans were Utopian, and that they were impracticable and impossible. It was a question of getting together interests which are naturally conflicting, and people spoke of it as though we were trying to bring about the millennium.

Now, the men who are on the Board of Directors of the Society and the men who are on its Executive Committee and Committee on Plans are all hard-headed, practical business men. Every one of them with that keen American sense of the value of the dollar and how to get it. It took us until February of this year to secure the necessary pledges to enable us to go to work. It was decided that it would be no use attempting to work until at least \$200,000 had been pledged, and as last year was a difficult year to raise money, it took until February of this year to get it. Our subscriptions are based on one-fifteenth of one per cent. of the annual business of the Central Station or manufacturing member. That is to say, a matter of 66 cents on a thousand dollars. It is a matter of \$666 on a million dollars' worth of business. So you see the dues are light. And in the case of a jobber, dealer, contractor, they are one-twentieth of one per cent., which is a matter of only 50 cents on the thousand dollars, and it represents a tremendous volume of business to get \$200,000 on that basis. But we have to-day 1,382 members with this \$200,000 pledged, and within the last few weeks we have commenced our actual work.

The plans were drafted by a committee upon which were represented the various interests of Central Station, manufacturer, jobber, dealer, contractor.

They were submitted to the Executive Committee and approved. We have divided our work into sections. In our first we have two men travelling throughout the country forming local leagues, organizing local interests into local electrical clubs, getting together the various interests—a local organization where the Central Station men and the dealer and contractor can meet and discuss their mutual problems without feeling that one or the other is coming to that meeting to grind an axe. I do not know how it is in Canada, but in the United States it is a very common thing to find that a Central Station man is regarded by the dealer and contractor as an unfair competitor, and is very often unfairly criticised by the very man who should be working with him and for him in the development of the industry in his city. Our idea is to get the Central Station man, jobber, dealer and contractor to share in the work of intensive local cultivation, cultivating the local market between them. Heretofore the Central Station man has been left to bear the load himself, and local interests have sat back and criticised him because he took the business. Now, we want the local dealer and contractor to go after it with the Central Station man, in return for which we ask the Central Station man to give the local dealer and contractor an opportunity to do good work at living prices in his city. We are not attempting to interfere at all with the policy of the Central Station in regard to handling supplies or anything of that sort, but we do ask them in all fairness to maintain a proper business condition in towns where we are able to get the local dealer and contractor to help him develop the market. That is one of the objects we are after in Section 1.

Another is to render aid to the Central Stations requiring assistance in directing a new business-getting campaign. A great many Central Stations are managed very efficiently so far as the station is concerned. They have good engineers and a good plant and it is all being done in a very good style, but they are not getting the business. The men at the head of it are not always business men, and they call upon us to come down there and diagnose the difficulty. When we come in and tell them they ought to have a house-to-house canvass or ought to do some advertising and ought to do this and the other to increase their off-peak load, they say, "Yes, that sounds all very well, but we have not any man here to conduct such a campaign, and we cannot afford to hire a man and put him on the staff." Part of our work is to find men for such positions for just the length of time a Central Station wants him. We will diagnose the case for any of our members and find a man who will come to him and undertake to do that work for a month or six weeks or two or three months, according to the size of the town. Of course the expense of that campaign is borne by the member, not by the Society.

I might cite the case of Toronto—Mr. McDougall will bear me out—that we sent a man there to undertake some work for the Toronto Electric Light Company, and Mr. McDougall was kind enough to say that he had earned the annual subscription of their company for the next ten years.

Our Section No. 2 consists chiefly of a travelling engineer, a man who has had 20 years' experience designing motors for industrial purposes. He is travelling now throughout the country investigating the various uses

of electricity in the various industries, reporting on how electricity is so used, why and what economies are effected, and suggesting further uses of electricity in those industries; why things should be done electrically which are not already so done; how they could be done electrically and what economies can be so effected. That information is sent in to us by the travelling engineer and compiled in Section 3, which is in charge of another electrical engineer who has had great experience in collating, indexing, filing and distributing information. It so happens that the subject you are discussing this morning, electrical heating and cooking, is one of the subjects which we are now investigating. We are gathering a tremendous amount of data, statistics, information as to rates, information as to results, from all over the United States. And that information is available for our members.

Just this present week, through one of our connections in the Society, we are going before Governor Glynn of New York State with the suggestion that electric heating and electric cooking, particularly the electric cooking, be installed in the State institutions, and we expect to have everything done electrically in the State institutions; going after it on the cold-blooded business basis of cost, we believe we can get it.

Section 4 is a publicity and editorial department, through which we disseminate any items of genuine news of human interest to the daily press, popular magazines, trade papers, technical journals, etc., those items distributed to the daily press being intended to develop the off-peak load of the Central Station. As, for instance, last week or the week before last we had a little story of about half a column which ran in over 8,000 daily newspapers, including the large Canadian dailies as well as American dailies, in regard to the use of fans; not signed by the Society, not signed by anybody, simply handed to the press and printed in over 8,000 daily newspapers. That means several million readers reached by that means. It is the kind of publicity in which you grind no one's axe. It is sent out as a matter of human news, human interest, and the press takes it on its merits. No one Central Station can do that; it is got to be done through the Society for Electrical Development, which is recognized not as a money-making concern but as one distributing facts, and we get into the daily press stories which are of particular interest to the consuming public, with the idea of teaching them to do things electrically. It seems to me that it is easily recognized that that is something which is of great value to the Central Station.

We have had prepared a number of motion picture films. They have no advertising in them at all; they do not profess to advertise the use of electricity any more than they profess to tell the story of the comedy or whatever it may be, but they are being shown throughout the country and in every case exhibit the use of electricity in the home. Moreover, we are supplying the props to a number of film companies, so that whenever they are making their ordinary comedy films where the woman is sweeping the house, instead of using the old-fashioned broom she uses the electric vacuum cleaner, and if the scene is in the kitchen she is using an electric range or an electric oven, and if a supper is being given it is being given with an electric chafing dish; the idea being all the time to keep before the people when they are being amused an interest in electrical things. And you know the

attendance in the motion picture shows runs up to several millions daily. This constantly brings the idea before them to do things electrically.

Another department which we have which appeals particularly to the dealer and small jobber and Central Stations handling supplies is the department which we speak of as our Window Display Service Bureau. We have a studio in New York where we trim windows. The man who is engaged to take charge of that particular branch of our work is the President of the Greater New York Window Trimmers' Association, a man who has had a great many years'experience trimming windows and arranging window displays. He, with several of his assistants, trims a window in the studio and it is photographed; the idea there being to get away from the glass and high lights and reflections which make it impossible to get a satisfactory photograph of a real supply store window. We have various sized windows, and they are photographed, two photographs being taken of each window, one showing the fixture setting and the other showing the completed window. These photographs are reproduced in half-tone and sent to all of our members. A series of them go out monthly. With them go printed instructions, showing how to get the results shown in the photograph; what the fixtures consist of, the fixtures being as simple as we can make them; because we have got a very large list of subscribers who are in small towns and who cannot afford to buy extravagant window fixtures. In some cases the fixtures may be simply a barrel sawn in two standing up on either side of the window and covered with crepe cloth, but you can get your results, and the printed instructions that go with the window are instructions just of that sort. Now, this last month we sent out a window for the June Bride; two large red hearts across a background with an arrow struck through it; the whole thing beautifully trimmed and decorated; the window containing coffee pots and percolators and chafing dishes, portable heaters, curling irons, toasters, and all sorts of little devices suitable for wedding presents, and I can assure you it did not look like any supply store window I had ever seen. Of course we are all familiar with so many of the supply store windows where there are fans, etc., not operating, and the office cat sleeps amongst the dust. This one was a window which would appeal to anyone, full of silverware, attractive and beautiful in its general effect, and it was used throughout the United States very generally during this past month, the idea being to suggest to people the use of electrical devices for wedding presents. We have one with all kinds of household devices set up, including ironing machines and washing machines, with a large card covered with imitation icicles reading "Keep cool electrically," the intimation being that you can do your housework and keep cool if you do it electrically. That window service runs right straight along, and at the same time any of our members who want a special service in that direction are at liberty to ask for it. So we are trying to take care of the big Central Station who is trying to develop his power load, trying to develop his off-peak load, doing work for him by our big publicity work, by our formation of local leagues, and by our collection of information and data for his use, and taking care of the jobber and dealer and contractor. It is a scheme in which all the various interests are equally represented on the Board and on our committees.

I am not here this morning to plead for members, but I have some booklets here which tell the story of the Society and our plans and our ideas. I would be glad to have anyone take them, and we would welcome all the Canadian electrical companies. We are not purely an American organization. It is national in scope and it is also international. We have now some 20 or 30 Canadian companies, and we would like to make that 200 or 300.

THE PRESIDENT: We are certainly very fortunate in having this broad-minded address from Mr. Wakeman. I think it often does us good to get above some of the technical details and look at the work generally, in a broad-minded way. And I am sure after what we have heard from Mr. Wakeman that he will be pretty well swamped by applications for further information and from different companies who wish to join the Society.

Now, if any of the members wish to make remarks on this subject or discuss it further, we will be very glad to hear from them.

A DELEGATE: I would like to ask Mr. Wakeman if the electrical inspection goes hand in hand.

MR. WAKEMAN: We have asked all the cities in the United States of 5,000 and over to send in their local inspection regulations, their various street lighting ordinances, and all that information is being collated in that commercial exchange bureau, and when it is all collected we expect to make a synopsis of the whole thing and send it out to our members, and one of the things which we hope to accomplish in this intensive local cultivation and closer co-operation between local interests is a better class of work by the contractor.

THE PRESIDENT: I would announce that we are going to have the pleasure of listening to Mr. Armand Higman this morning. I do not know that it is necessary to introduce Mr. Higman, as he is probably the best known electrical man in town.

MR. HIGMAN: Mr. Chairman and Gentlemen, if you examine your programme you will see that this is an extra, and it will be very similar to most extras—there won't be very much in it. I had no idea when I received the invitation of the Executive—and I wish to thank them for the courtesy extended—I had no idea that they were going to call upon me to say anything, and consequently I have nothing prepared.

Doubtless a few words as to what the department is doing may be of interest. I congratulate the electrical people of Canada upon their prosperity. As you must know, our work is a fairly good barometer of what is going on electrically, and judging from the amount of work that we are now doing as compared with four or five years ago, it would indicate that there is great expansion, and I sincerely hope great prosperity in the electrical industry.

In 1908 the department tested throughout Canada 33,000 electric meters. Last year we tested nearly five times as many, or 150,000, and this year, although the installation of new meters is not perhaps so great as it has been during the past few years, still the increase will be fairly well maintained. With the gas inspection added, our total tests throughout the country for 1913, that is, at the end of March, 1913, amounted to over 200,000. I might say that we are completing our system by establishing branch laboratories

at Vancouver and Winnipeg. The laboratory at Vancouver is now nearing completion, and will in a few weeks be ready for operation. The building to be occupied at Winnipeg is now under construction, and we hope to have the installation completed by the end of the present fiscal year. I think that I may fairly say, without any exaggeration at all, that when these standardizing laboratories are completed that they will compare most favorably with anything of the kind on the continent. In each there will be employed a first-class instrument maker with all the necessary tools and machinery for adjusting our standards and the instruments of the electrical companies if they feel disposed to take advantage of our equipment. We do not, of course, undertake to make structural repairs, but simple adjustments and checking. The fees for such work are very reasonable, indeed they may be classed as nominal.

As many of you are interested in gas works as well as electricity, it may be interesting for you to know that a circular is now being sent out advising the companies of a change to be made in the inspection work of the department from the 1st of April, 1915. The illuminating power test and the test for sulphur and ammonia will be discontinued, but the test for sulphuretted hydrogen will be continued because of the poisonous nature of this gas. In place of the tests that will be discontinued we shall introduce the calorific test; that is, the heat value of the gas. We are selecting after very careful investigation the Total Heat Calorimeter manufactured by Alexander Wright & Company of London. These are now being distributed, and the inspectors will be duly instructed in their use, and we hope everything will be in readiness for the commencement of these tests on the 1st of April next.

I do not know that there is anything more that I can say at the moment. If any gentleman present wishes to ask a question in regard to our work, I shall be very pleased indeed to endeavor to answer him.

Mr. D. H. McDougall: I would just like to ask if you could tell us from your broad knowledge of conditions in Canada approximately the amount invested in electrical plants, both private or municipal plants, or private plants especially in Canada.

Mr. Higman: Taking the whole list of companies registered under the provisions of our law, and that list comprises about 500 companies, from a fairly careful investigation I make it out to be something over $300,000,000 for electricity and about $55,000,000 for gas.

The President: Would that include street railways?

Mr. Higman: Yes, wherever the electric lighting company, such as the British Columbia Electric Company and the Winnipeg Electric Company, includes both branches of the work. Such companies are registered as electric lighting companies. We make tests, of course, for all companies, and in endeavoring to find what the invested capital is I think it is only fair that we should cover the total invested capital of such companies. The number of operatives employed would be approximately 120,000. So that, speaking not too closely, of course, there would be about $300,000,000 invested by the 500 companies and 120,000 operatives employed.

Mr. A. A. Dion: I wish to ask Mr. Higman if the department has considered the question of getting manufacturers who sell meters in Canada

to follow standards as to connections and dials and that sort of thing; also whether the department has gone into the study of maximum demand devices ?

Mr. Higman: With regard to the matter of maximum demand meters, I may say that only one manufacturing company has up to the present time presented a meter of that description for approval. The question has been brought before the department as to what might be considered a fair time limit. I am told that in some places where the Hydro-Electric Commission operates that they are insisting upon a one-minute period, and I will say frankly that I do not consider that this should be adopted as a standard. I am of the opinion that any meter with a time limit of less than 10 minutes should be passed under the law. For instance, under a one-minute period a ground or short circuit in a motor might be the means of penalizing your customer through no fault of his, and it does not appeal to me as being a proper standard. What was the other question?

Mr. A. A. Dion: The standardizing of meters in regard to connections; whether connections should be on top or bottom, and as to the dials.

Mr. Higman: While we have not made any regulations in that respect, we have informed companies who are presenting meters that we require the connections to go in at the left and out at the right, and we have laid down a certain dial standard, that is, for the clock dial. For the cyclometer dial there is nothing much that can be said except that the numerals be of the right character. We send out a blueprint to every manufacturer as to the standard dials we would like adopted. We have not enforced this in the shape of a regulation, but have asked that the dials be legibly marked, "units," "tens," "hundreds," "thousands," similar to the marking of gas meters, so that they may be easily read by the uninitiated. I think it tends to maintain harmony and good will among customers and the supply companies, and this is a condition of affairs devoutly to be hoped for.

Mr. D. H. McDougall: I understand from Mr. Higman's remarks on demand, about which we are to have a paper next on the order, that the department contemplates standardizing a demand and practically laying down a regulation as to the duration of that demand. This seems to me hardly a matter for departmental regulation; it is a matter of bargain and the matter of equipment, class of service, and it seems, without wishing in any way to create a discussion or raise the point or interfere with the department in any way, it is something that is rather dangerous ground, requiring a study of conditions in each case. A man running a compressor with fluctuating load, his ten-minute demand is not to be compared with ordinary normal load, and conditions will govern in a great many cases, requiring a different time duration. It seems to me that to establish a ten-minute demand as an arbitrary basis of charge is rather a limitation on the company, and possibly selecting some classes of business for favored treatment as to rates. It seems to me largely a matter of bargain between the consumer and the company as to the demand duration and not a matter that can be equitably governed by regulation of the department.

Mr. Higman: Mr. McDougall is no doubt right, generally speaking, but, if a meter is presented to us with some sort of mechanism claiming

to do certain things, the question immediately presents itself, How will this added mechanism affect the integrating part of the meter? Because, you know, there are two sides to the question, in so far as the department is concerned. While we are always ready—and I think the record will prove this—to consider most favorably any suggestions made by the companies, still there is the other fellow to be considered. I know that we have dealt generously with the producing companies, still the consumer also demands something at our hands. He must be protected, and any device submitted to us that is in any way likely to penalize him could not very properly meet with approval. I will ask you to take that into consideration, at any rate, in passing judgment on what the department may do.

Mr. D. H. McDougall: Without wishing to extend this debate beyond reasonable length, I would like to point out that, naturally, the jurisdiction of the department covers all Canada, whether it is a question of governmental meters or other meters, and consequently Mr. Higman's contemplated ruling of ten minutes would invalidate some very important Court decisions, among them the question of measurement of power at Niagara, which is based by the Ontario Government on an instantaneous maximum demand, and it is a question that should receive and will receive, I have not the slightest doubt, very great consideration before any definite ruling is made.

Mr. Higman: I may say, in regard to the wholesale use of electrical energy, that I had not that in mind at the time. When you are dealing with that phase of the question you are dealing with experienced electrical engineers as consumers, and they are quite capable of looking after their own interests; but where you are dealing with small users who may be using a few H.P. and you put in instruments of a description of which he knows nothing, then I think that we may possibly have to act for him. I wish to say that ten minutes has not been fixed. The only instrument that we have passed has a time limit of 15 minutes. As to the question of selling electrical energy in large quantities, I do not know that we are called upon to do more than to see that the measuring device is correct.

The President: Would there be any objection in standardizing, say, three or four different periods of maximum demand? For example, say there should be a meter having a one-minute period and another ten minutes and another twenty. So there would then be meters to suit all conditions of loads.

Mr. Higman: The matter, of course, has never been put up to the department, and I may say frankly, we have not considered it very closely. When the time shall come for decision you may rest assured that nothing will be done until the fullest investigation has been made, and we shall endeavor to give every consideration to the different views presented.

Mr. Wills MacLachlan: I might say that our own company, although having a demand of less than ten minutes, allows an average of four types of five-minute demand during the month and in this way gives a longer period really than five minutes in working out the demand.

And in this connection I would like to move a hearty vote of thanks to Mr. Higman for giving up so much of his valuable time and coming to our meeting, and giving us so much valuable information from a department we are so closely in contact with as Central Stations in Canada. (Applause.)

Mr. Higman: I can simply say, I am only too pleased to be here to meet with you all. It is my business as well as my privilege to give my time to the requirements of the work.

The President: The next item on the programme is a paper by Mr. W. B. Johnson.

CO-OPERATION IN THE SELLING OF COOKING AND HEATING APPLIANCES.

By W. B. Johnson

Many papers have been presented at former conventions outlining selling campaigns on different electrical appliances, which have proven more or less successful, but have we given the subject of co-operation with the electrical dealers and departmental stores the thought and consideration that it should have?

Many of these special campaigns have been conducted on so close a margin that the profit on the appliances did not begin to pay the actual expenses. No doubt there were a great many appliances disposed of during these campaigns, but if they were sold at a loss, both of money and the good-will of the electrical dealers, were they as much of a success as they might have been?

We want to bear in mind that it is not the price that sells an appliance, but it is the desire for that particular article which is the foundation of the sale.

To create the desire for all kinds of appliances should be our aim, but how to do so with best results is the question we are all anxious to solve.

An organization has quite recently been formed composed of manufacturers, jobbers, dealers and Central Station men whose aim is to promote the use of electricity in all ways possible, and they have taken as their motto, "Do it Electrically." We cannot expect the other interests to be enthusiastic along this line unless they are going to get a fair chance at the business, which they do not get when we sell appliances at practically cost.

To obtain the good-will and hearty co-operation of the electrical dealers, we must sell appliances at a high enough profit so that they can also afford to carry a stock.

It costs the average dealer from 20% to 30% to sell goods, and we must remember that he gets only one profit out of them, for nowadays, with the five-year, ten-year and perpetual guarantees by the manufacturers, he stands very little chance of making any money out of repairs.

You will find where dealers handle appliances that the proprietor and all his employees are good boosters for that class of business. By this you will see where the lighting company will have an army of boosters and salesmen who will do more good and whose word will have more weight with the consumer than that of any employee of the company.

Many claim that dealers carry a class of goods that are a hindrance and a draw-back to the appliance business, but I believe that it is only a question of time until things will correct themselves.

In this day and age of keen competition it is not only the dealer but also the manufacturer who must put out the very best he can get in order to continue in business. Of course, you may once in a while find a manufacturer or a dealer who does not figure on future business; but they will not last long, and I do not believe that all should be condemned for the acts of a few.

I believe that most electrical dealers and departmental stores are just as anxious to handle the best class of goods obtainable as is any electric light company.

You will find very few lighting companies to-day who carry more than two or three makes of electrical appliances, and we must admit that there are others on the market that are just as good, if not just as desirable, from our point of view.

There are perhaps some who believe that the sale of appliances should be left entirely to the dealers, but experience has proven that not only are more appliances sold but that the dealers themselves sell far more when the electric companies carry a line and promote the sale of same.

Lighting companies should do all they can to promote the sale of appliances by window demonstrations, personal solicitation, advertising, etc. This not only brings in extra business for the company, but it also boosts and helps the sale of appliances by all the other dealers in the city.

We should also endeavor to induce architects to specify outlets for appliances on all contracts for house wiring.

The company should quote a fair rate for current for electric ranges, for it is surprising the number that are being sold every month. At most of the summer homes electricity is available for lighting and no other method of cooking than the coal range, which heats up the entire house and which is what they are trying to get away from.

This class of business has not received the attention it should, but I hope and expect that it will not be many years until every summer home will contain an electric range if near enough to the lines of a Central Station to obtain current.

The cutting of prices by dealers is something I regret very much to see, and believe it is the only condition that justifies a lighting company in reducing prices.

Dealers should bear in mind that Central Stations can buy just as cheap, have possibly a better selling organization, and can afford to sell appliances at a far less profit than they can.

Very few lighting companies have given industrial appliances the consideration that they should receive, and I believe that results will warrant the employment of a special salesman for at least part of the time. I do not mean that there will be so many appliances sold that it would be profitable for an electrical dealer to put out a special representative, for there are not as many prospects, nor are they as likely to purchase, as with household appliances.

A great many claim that a company is justified in selling appliances at actual or less than cost, for that thereby you can get the appliances out and in use quicker and that we look to the current consumption for our

profit. If that is your line of reasoning, why not go a step further and give all kinds of appliances away free of charge?

Selling them at actual cost may sell them a little faster for the first year or so, but I believe they will be discarded sooner than when purchased at a fair price and when there is a steady sale on them.

Where dealers sell appliances it is almost impossible to keep a record of all of them connected to your lines, but is that so necessary? We do not try to obtain reports of all appliances installed in this city, but if we get paid for the current consumed we are grateful.

We do not aim to sell all the appliances sold in this city, but on what we do sell we aim to obtain a fair profit. I do not believe that we sell one-half the appliances sold in this city, but it is immaterial to us who sells the article as long as it is used on our service.

DISCUSSION.

The President: I think we ought to have some good discussion on this paper.

Mr. J. S. Gould: I think it would be a good idea if a copy of that paper were sent to Sir Adam Beck. (Laughter.)

Mr. Coleman: In the sale of appliances as ordinarily conducted, whether by local dealers or by Central Stations, matters considerably. As a general thing the local dealer knows nothing about the appliance he is selling, and when he comes to sell appliances he generally gets the cheapest he can buy, thereby getting on our lines an inferior class of article. Now, what we, as sellers of electricity, are concerned in is an appliance that will give satisfaction so that people will keep on using it. We want good appliances put on our lines.

Mr. Smith: I cannot agree with the writer of the paper that it is advisable to allow dealers in a small town to sell heating and cooking appliances. I have found, if I left it to the dealers, they would not be sold. In the first place, they don't know anything about the line they are selling and they do not take the same interest in it. In the town I come from, some three or four years ago we left it to the contractors or dealers, and the consequence was there was nothing doing. We opened an electric shop about two years ago and it has been one continual boost of electric heat and cooking utensils right along. Last year on one day, through advertising, I sold 40 utensils, out of a possible of 225 customers. This year I sold 35. I have over 200 electric irons on circuit. If it is left to the dealers there would not be one-tenth of that number of appliances in use. As Central Station managers it is our business to get them out, even if we sell them at a small profit. I believe in a reasonable profit. I do not believe in cutting prices to get them sold, but get them working for us.

Mr. Scott: I cannot agree with the last speaker that we ought to cut out the sale of these power appliances. I think it behooves every Central Station store to handle the best appliances themselves, the best they can get on the market. The public in general may not come to them in the first case for appliances, but there is no appliance on the market but what will show what great advantage can be gained by doing things electrically, and

while the local dealer, whoever he may be, sells appliances and makes a profit out of them, it is going to become generally known in the town who handles the best electrical appliances and how they stand up. And if every Central Station gets the best he can, why I have no doubt he will soon have all the business coming his way.

There is one matter that Mr. Johnson has not touched upon that is particularly of interest to me at the present time, and that is in the sale of lamps. I think that is one place where the Central Stations have got to keep a keen eye. The people are changing their old 16-candle-power for 25-watt Tungsten. It is of great interest to me to know whether you ought to put out on your counter 60-watt lamps, 40-watt lamps for exactly the same price as you sell 25. You have got to get those people to light their homes efficiently. If they are going to pay more for the larger sized lamps it is going to make a difference.

Mr. Wills MacLachlan: Carrying on Mr. Scott's discussion in regard to lamps, I think it is a very important one, and one that ought to be brought out. I think it is almost impossible to push the 60-watt size for house use, especially in the average house, as I think the 60-watt lamp is a little outside of the range that can be used. I think the 40-watt lamps certainly ought to be sold at the same price as the 25-watt lamps, and a lower wattage than 25 watts ought not to be handled by Central Stations, but left to the dealers, as lower sizes than 25-watt lamp give a very bad light on test, as far as our tests show, and we have carried on rather extensive ones during the past winter. I would like to hear a little further discussion what the other companies find, and hear in regard to the price of 25 and 40-watt sizes.

A Delegate: Out of personal curiosity I would like to have Mr. Johnson answer his own question. He says that if you sell an appliance at cost, why not give it away? Theoretically it seems to me, as Mr. Brown says, 70 cents is the income from an electric iron for one month, that is an income of $8.00 a year. An electric iron is worth about $3.00. Would not that be a fairly good investment to get $8.00 in, even if you give the electric iron away?

Mr. A. A. Dion: I think that undoubtedly Central Stations should keep appliances and should keep the very best that are on the market and thus set the standard, no matter what anybody else may do in the city, and that it should sell those appliances at a fair business profit, if only not to antagonize the dealers, but rather get them to work for us rather than against us.

I think that lamps of 40 watts should be sold at the same price as lamps of 25 watts. Our experience has been in selling these two lamps at the same price, that we have sold as many of 40's as we have sold 25's, and I am sure the result would have been different if we had asked a higher price for the 40-watt lamp. I think our consumption has been increased thereby to some extent.

Mr. Wills MacLachlan: Might I ask Mr. Dion if he sells anything less than 25?

Mr. A. A. Dion: No; do not keep anything less than 25-watt.

Mr. Smith: I agree with what Mr. MacLachlan and Mr. Dion have said in reference to the sale of 40 and 25-watt lamps. For residential lighting the 60-watt is entirely too much, and as 40 and 25 cost the same price, why should not they be sold at the same price? I do not recommend anything smaller than 25-watt lamps, simply for the reason the light of it I have found unsatisfactory, and when the customer has to pay the same price for 25-watt as he pays for 25 or 40, it is not a very hard thing to sell the larger size lamp.

The President: If there is no further discussion on this subject, I will ask Mr. Johnson to reply to the questions that have been asked.

Mr. W. B. Johnson: I do not say that electrical companies should not handle appliances. An electrical company should handle all kinds of electrical appliances and push that business hard. Every cent of profit that is derived from the appliance should be used in developing the business and pushing the appliance game. This not only helps yourself, but it helps the dealer, and by maintaining your price you will sell just as many as if you were selling them at a less price. That is, you personally will not sell as many, but the dealers will, and they will go on your line just the same. As I say here, there are very few companies that handle more than one or two makes of electrical appliances. There are a good many companies that only handle one make of flat-iron. We cannot say that all other makes except that one particular line they carry are not what they should be. There are other makes on the market that are just as good and you will find that dealers will carry a good line of goods. Now, we have been selling appliances here at a good stiff profit, but at the same time, by doing that, it gives every dealer a chance to handle the class of appliance and he will push it on that profit. If you are going to cut your prices down where they cannot afford to handle them they are not going to push the business, and you will naturally find that they will knock the business rather than tell a person, No, they do not carry them. They will say they do not believe in them and things like that. We should make a good fair profit on appliances but we should use that money in developing the business all the way through. I have had experience in cities where electric companies have not handled appliances at all. I will admit that where the electric companies do not carry them that the dealers do not push them the way they should, but where you take hold of the game and push it, they naturally fall in line and push it all the way through.

In regard to the question about giving away appliances, I asked the question, but I do not believe in that principle.

As to the revenue of 70 cents per flat-iron, that is certainly more than we are getting out of the irons with our present rate. I think in years gone by we got that revenue, but at the present time we do not.

In regard to the price on Tungsten lamps, I wish to say that we maintain a good price on lamps; in fact, about the same price as the dealers do, and we charge the same for the 40-watt as we do for the 25-watt. We put a higher percentage of profit on the small lamp than we do on the larger one.

The President: The next paper is on the important subject of "Maximum Demand," by Mr. P. T. Davies.

MAXIMUM DEMAND DETERMINATION AND ITS RELATION TO THE COST OF SUPPLY OF ELECTRICAL ENERGY.

By P. T. Davies,

Montreal Light, Heat and Power Company.

In the sale of power developed from hydro-electric plants, a short study will usually show that the basis of sale should be on a demand basis, and that the use of the demand has little effect on the cost of production.

Under present conditions it is found that the maximum demand of an individual consumer is the most important feature from the standpoint of cost of supply—the use of the demand only affecting the diversity factor of the supply system.

Diversity factor, which is the *raison d'être* of the present day supply plant, is, however, a matter which should be considered in determining a demand, and the only method by which this can be taken into account is by choosing the method of determination with due regard to the possibility of coincidence of demand.

Before proceeding to discuss the question of determination, it should be noted that the question of maximum demand is of equal importance in the operation of a steam plant as in the case of a hydraulic plant, and it is becoming more generally the practice to make rates for power supplied from steam-generated supply stations of such a nature that a definite return per horse-power of maximum demand is guaranteed. In this connection it is interesting to peruse the report to the Committee on "Gas, Oil and Electric Light," on the investigation of the Commonwealth Edison Company.

The following illustrative figures have been extracted from this report in order to show the small part which the actual production costs bear to the total cost of supplying electrical power. These figures have been chosen with particular regard to the railway and bulk supply customers, who have, naturally, very much better load factor than the rest of the

customers, and whose use of maximum demand and, therefore, operating cost per horse-power would be materially higher than that which would be apportioned to the average customer.

These figures show as follows:—Year 1911: 443,428,100 kilowatt hours sold for bulk supply. Production costs $1,579,712.00, of which, however, $213,759.00 does not depend upon kilowatt hour use, making $1,365,953.00 which can be traced to production costs, pure and simple. Transmission, commercial, general, and miscellaneous expense, $716,105.00.

In 1911 the kilowatt hours sold for lighting amount to about 130,000,000, for power about 75,000,000, and for railway load 445,000,000. At the same time the connected loads show 190,000 K.W. for lighting, 120,000 K.W. for power, and 110,000 K.W. for railway load, making a total railway and power load of 230,000 K.W.

It will generally be admitted that the maximum demand of the railway and power load will be a higher proportion of the connected load than that of the lighting, and if we take the maximum demand of 40% on the connected load for lighting, we will be taking a very liberal figure—40% of 190,000 = 76,000 K.W., which, deducted from the maximum load of 199,000 K.W., the maximum load of the system, gives us a power load of 123,000 K.W., or 62% of the total load.

If we apportion 62% of the fixed charges, including depreciation, to the power load, we shall not be putting on too heavy a charge, in view of the fact that approximately 80% of the kilowatt hours sold are sold for railway and power use. While the report does not show the amount set aside for depreciation, we have, however, the following figures:—

Table No. 4—Expense including Depreciation	$10,647,052.00
Table No. 10—Expense excluding Depreciation	7,007,980.00
Difference = Depreciation	$ 3,639,072.00
Interest	1,563,774.00
Dividends	2,221,474.00
Total Fixed Charges	$ 7,424,320.00
62% of this	$ 4,603,078.00
Add General Expense—62% of $716,105.00	443,985.10
As above, operating expenses were shown to be	1,365,953.00
Giving a total of	$ 6,413,016.10

Of which the fixed charges are 78.5%, showing that on a steam-driven plant with a very high load factor the fixed charges are far and away the most important item in the cost of supplying the energy.

In order to investigate the proportion which the fixed charges bear to the operating charges in a hydraulic plant, the following figures have been taken as representative of a moderate sized hydro-electric develop-

ment of medium head, operating at a distance of 30 miles from a main market for power:—

	Capital Cost per H.P.	Depre-ciation. $ per H.P.	Interest at 5%. $ per H.P.
Cost of Hydraulic Development, including Dams and Power House, per H.P.......	$70.00	2.10	3.50
Water Wheels and Electric Generating Plant, including Switchboard...........	30.00	3.00	1.50
Step-up and Step-down Transformers and Necessary Oil Switches................	5.00	.25	.25
Transmission Lines, including Right-of-way................................	15.00	.90	.75
Receiving Station.........................	5.00	.25	.25
Switchboards for Local Distribution and Wiring................................	1.00	.05	.05
Regulators for Local Distribution and Wiring................................	3.50	.35	.17½
Cost of Service taken at an Average Distance of Two Miles from Receiving Station................................	10.00	.80	.50
Customers' Transformers and Individual Services................................	4.00	.40	.20
Totals..........................	$143.50	$8.10	$7.17½

Interest at 5% on Capital Cost of $143.50 per H.P..............	$7.17
Depreciation per H.P..	8.10
Taxes and Incidental Fixed Charges on Meters, etc.............	.50
Total Annual Fixed Charges per H.P. Installed.............	$15.77

The actual operating charges on a medium-sized plant taken over a period of a year, taking into consideration a 25% steam reserve, runs as follows:—

MANUFACTURE.

Wages of P.H. Employees..............................	$3.20 per H.P.
Generating and Distributing:	
Oil and Waste..................................	
Ice Expense....................................	
Heating and Lighting...........................	
Sundries.......................................	
Flashboards....................................	
Steam Power Plant:	
Fuel...	
Wages..	
Oil and Waste..................................	
Water..	
Ash Handling...................................	

Distribution:	
Poles and Lines	
Inspection and Testing	
Pole Rental	
Fire Patrol	$0.53 per H.P.
Moving Poles	
Labor on Connections	
Testing Meters	
Changing Transformers	

MAINTENANCE.

Power House:	
Buildings	
Dams	
Crane	
Water Wheels and Equipment	
Dynamos	
Electrical Equipment	
Transmission Lines	
Crane	
Cables	
Conduits	
Distributing Stations:	$2.68 per H.P.
Crane	
Transformers	
Elec. Machinery	
Steam Station:	
Engines	
Boilers	
Belts	
Pumps, etc.	
City Distribution:	
Poles and Lines—Subways and Conduits, Meters, Transformers, Tools and Machinery	
Total	$6.41 per H.P.

Now, it is very obvious that few of the above operating charges themselves are affected by the running or not of the plant, and if we apportion 50% to fixed charges and 50% to running, we get

A total fixed charge of	$18.97 per H.P.
And a running charge of	3.21 per H.P.

Or fixed charges = to 86% of total expense.

Now, if the fixed charges are the basis of the expense of operating the plant, what factor in the use of power by a customer is the one which affects the proportion of the fixed charge which should be borne by such customer? Without doubt, it is primarily the amount of plant, transmission line,

receiving station capacity and city lines capacity which is required for the supply of power to the consumer which cannot be used at the same time for the supply to other customers.

Diversity factor or the non-coincidence of consumer's demand is, as previously stated, the reason for the existence of power supply stations, as even the decreased capital cost of large units compared with small units, the decreased operating and engineering costs following the handling of large amounts of power, together with the fact that very best engineering talent can only be supported by the large plant, would not overcome the cost of running an individual plant which requires no transmission line or costly water-power development were it not for the fact that non-coincidence of consumer's demands enables the large plant to supply from one and a half to three times the sum of the individual demand of the consumer, whereas the individual plant must install sufficient capacity to take care of its maximum load.

In the determination of demand there are three methods at present in use, as follows:—

(1) Demand based on instantaneous peak.
(2) Demand based on lowest point of usage, during a stated interval.
(3) Average load during stated interval.

The first basis is, without doubt, a hardship on the consumer, and its use creates an apparently low schedule of rates for the attraction of consumers, which, however, only means that the consumer is billed on a high load at a low rate instead of at a good average load at a medium rate. Even if the price is kept at a reasonably low rate, the possibilities of instantaneous demands are always present, and, furthermore, an instantaneous demand is not necessarily a fair criterion of the amount of investment necessary to serve a customer.

The second method, although used in one or two instances, cannot be regarded as being a solution of the determination of maximum demand, as it is open to abuse—thus, a customer who may be paying upon the lowest usage during the highest 15-minute period per month, may have operations in his plant which are intermittent and do not last fifteen minutes. Furthermore, by prearranged methods it would be quite possible to arrange to defeat the ends of the contract by arranging to open the switch at any time when there is a possibility of a new 15-minute maximum being registered.

The third method is the one which is usually used, and it is the means used to obtain the demand by this method which will bear inquiry.

There are three points which it is intended to discuss:—

(1) Length of demand period.
(2) Number of demands to be taken.
(3) Whether a demand, once established, shall remain the billing basis for the balance of the contract unless exceeded.

A hydraulic plant has normally no overload capacity, while it is true that the possible output may vary from day to day and even during the

day, and, further, that water storage may be available and be used in such a manner that the load factor of the plant can coincide with the load factor of the system and water be conserved; nevertheless, the output of water wheels has a definite limit, and it cannot be overloaded in the same manner as a steam plant.

In order to obtain, however, a basis of working, it is necessary to assume that a short period of overload can be absorbed under normal operating conditions, and this period has been taken as two minutes.

In view of the fact that we can allow very little margin of overload on the generating plant, it is obvious that the length of the demand period must be chosen so that the possibility of coincidence of demands has a fair factor of safety in favor of the supply station.

The time of day when power loads reach their maxima is generally from 7 a.m. to mid-day and from 1 p.m. to 5 p.m. The figure of 5 p.m. may be questioned, but experience shows that nearly all industrial establishments show a drop in load after 5 p.m., due, no doubt, to the natural disinclination of workmen to start any fresh operation after this time, and also that prolonged preparation for home going is more the rule than the exception.

This gives us nine hours per day during which peak loads may coincide.

It will be conceded that a demand of less than five minutes would be a hardship on any industrial establishment if taken as the billing basis for a month or more, and we may take a five-minute maximum average demand as the minimum period of time which could be considered reasonable.

The chances of two equal 5-minute peaks overlapping for two minutes in nine hours is 67.5 to 1.

The chances of two 10-minute peaks overlapping two minutes in nine hours is 30 to 1.

The chances of two 15-minute peaks overlapping two minutes in nine hours is 19.3 to 1.

The chances of two 20-minute peaks overlapping two minutes in nine hours is 14.2 to 1.

We have, however, 30 days during each month upon which equal daily demands on two systems may coincide, and this reduces the chances to the following:—

Two 5-minute peaks coinciding two minutes............	2.25 to 1 against.
Two 10-minute peaks coinciding two minutes...........	1 to 1 against.
Two 15-minute peaks coinciding two minutes...........	.643 to 1 against.
Two 20-minute peaks coinciding two minutes...........	.474 to 1 against.

If we now consider a larger number of peaks than one, we obtain the following comparison:—

Two 5-minute peaks on each of two customers coinciding two minutes..	1.15 to 1
Compare one 10-minute peak on each of two customers......	1 to 1

Three 5-minute peaks on each of two customers coinciding three minutes.. .75 to 1
Compare one 15-minute peak on each of two customers...... .643 to 1
Four 5-minute peaks on each of two customers coinciding two minutes.. .55 to 1
Compare one 20-minute peak on each of two customers...... .474 to 1
Compare two 10-minute peaks on each of two customers..... .5 to 1

These figures show mathematically that, presuming similar peaks occur each day, that the chances of several five-minute peaks coinciding are less than the chances of prolonged demands equal in duration to the sum of the five-minute peaks coinciding.

The mathematical calculation of the possibility of coincidence offers a field that a short paper cannot investigate, and, in order to check conditions as obtaining, a random choice has been made of a number of graphic charts on industrial concerns, which occurred upon the same day—December 5th, 1913—and demands determined from them as shown on following pages.

It is unfortunate that charts having lower load factor and more pronounced peaks were not available, but the charts chosen offer a comparison, and further work can be done when better charts are available.

The five charts have also been combined into a totality curve, giving the diversity factor of the system, and offering a basis for the determination of the effect of the individual peak on the cost of supply.

PEAK LOADS.

	One 5 min. H.P.	Two 5 min. H.P.	Three 5 min. H.P.	Four 5 min. H.P.	One 10 min. H.P.	Two 10 min. H.P.	One 15 min. H.P.	One 20 min. H.P.
Chart 1.........	326	323	319	314	310	306	298	291
Chart 2.........	940	932	924	920	916	910	902	900
Chart 3.........	530	525	522	520	520	515	515	510
Chart 4.........	560	540	530	520	540	520	530	520
Chart 5.........	950	926	907	895	870	860	840	835
Sum........	3,306	3,246	3,202	3,169	3,156	3,111	3,085	3,056
Figures from totality chart.	3,940	2,880	2,830	2,800	2,880	2,800	2,830	2,800

Max. 2-min. peak equals 3,000 H.P. on totality chart.

While the totality chart may be one or two per cent. out at different points of the load, owing to the fact that the curves were taken from instruments that used paper with curved ordinates, special care has been taken to determine accurate results during the maximum loads, which appear as above for the totality chart and have been separately calculated from Chart 6.

These figures bear out the mathematical calculation closely, and show nearly the same coincidence as was calculated above.

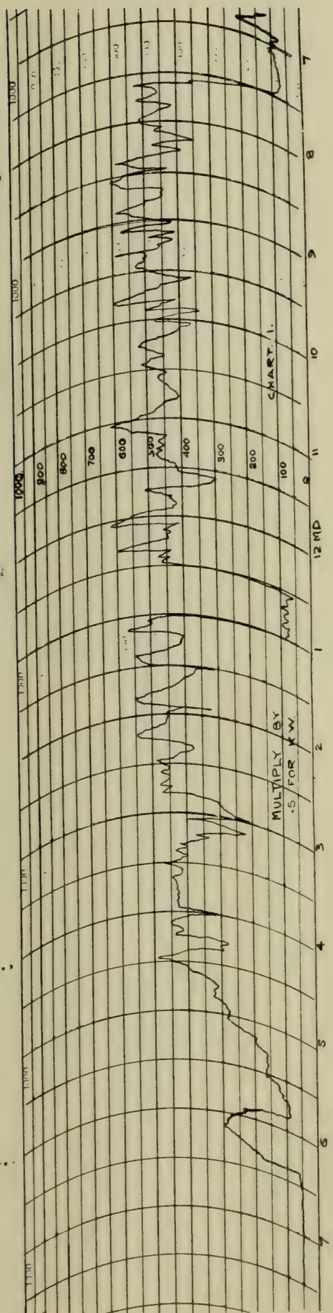


CHART. 1.
MULTIPLY BY
.5 FOR KW.

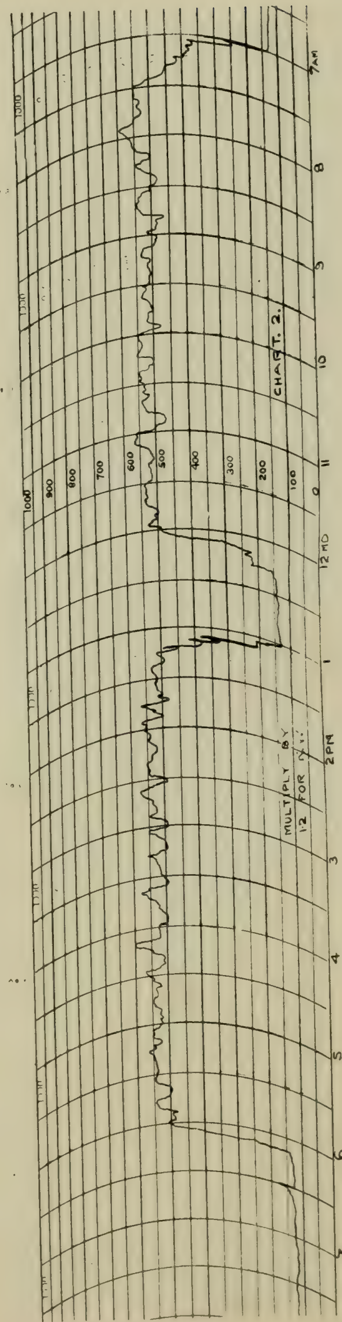


CHART. 2.
MULTIPLY BY
1·2 FOR

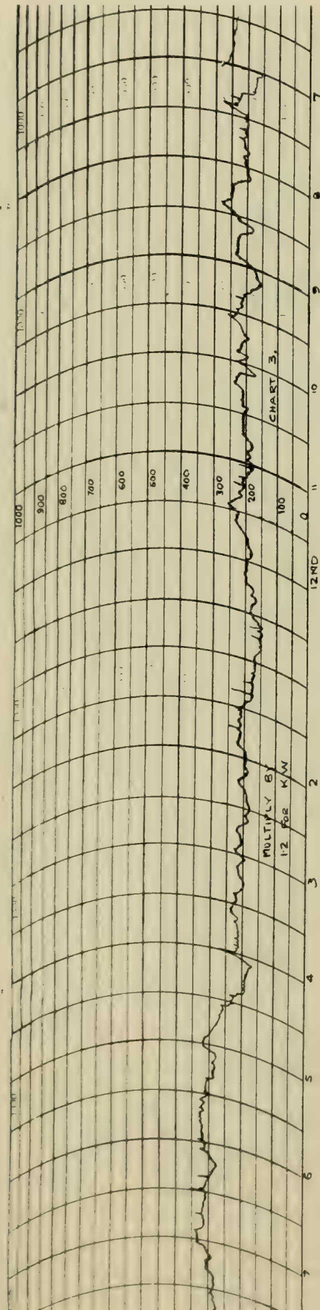


CHART 3.
MULTIPLY BY
1·2 FOR K.W
1000
900
800
700
600
500
400
300
200
100
0
12 MD

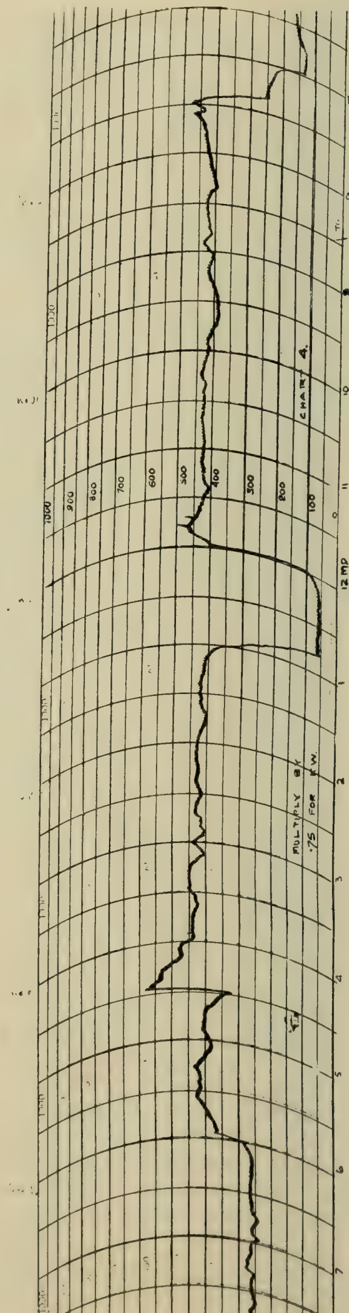


CHART 4.
MULTIPLY BY
·75 FOR K.W.
1000
900
800
700
600
500
400
300
200
100
0
12 MD

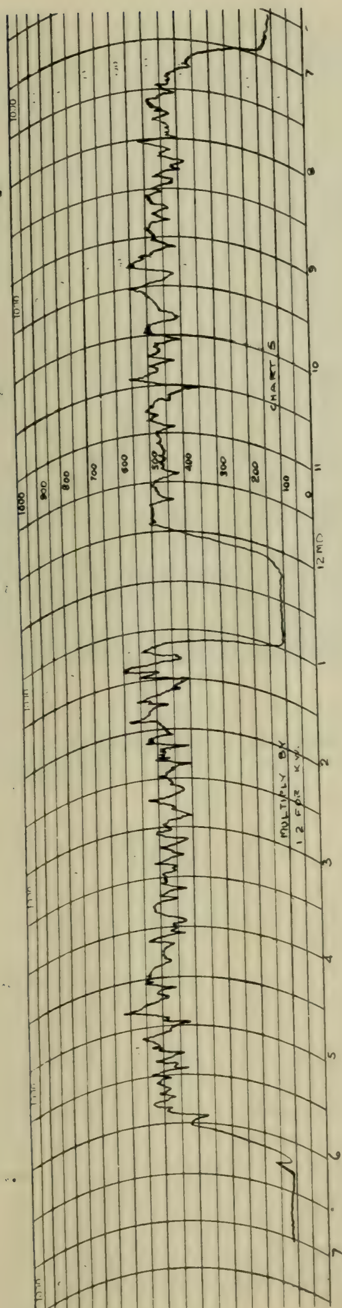
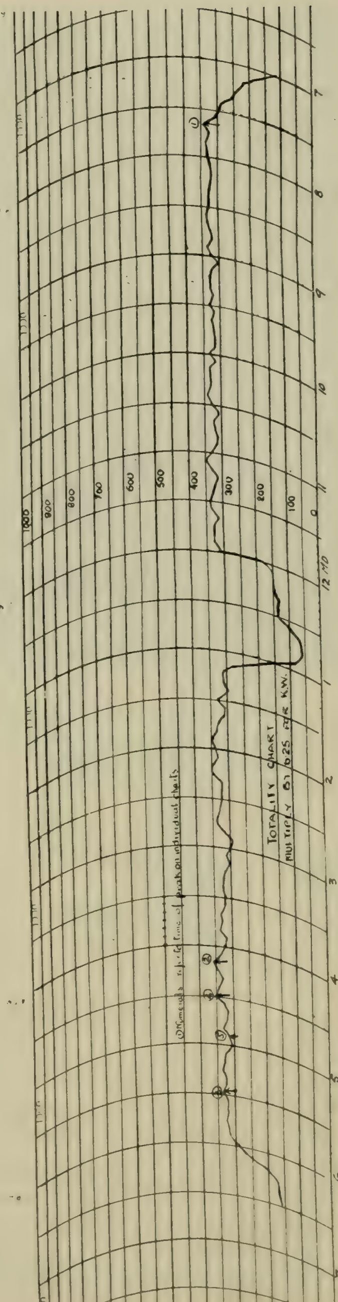
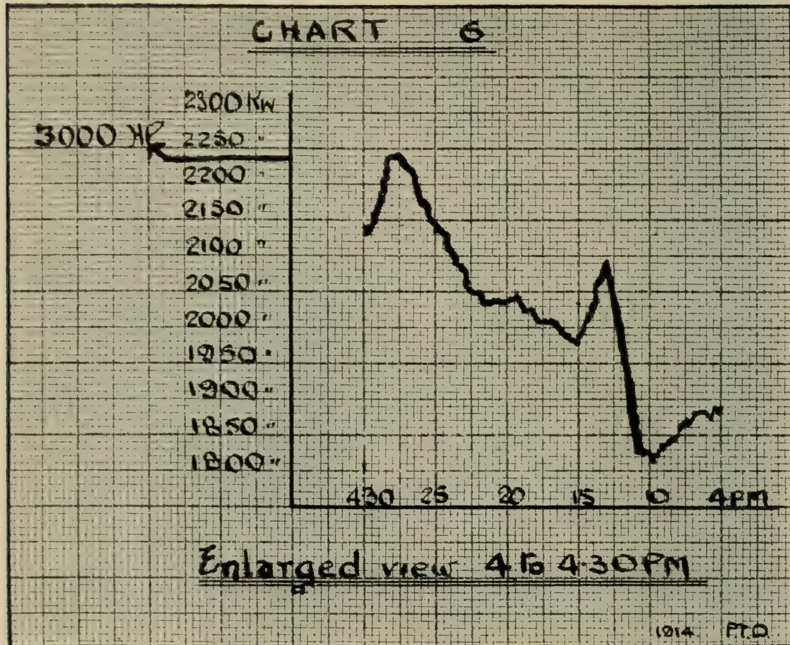


CHART 5
MULTIPLY BY
1.2 FOR K.W.


TOTALITY CHART
MULTIPLY BY .625 FOR K.W.
Numerals refer to time of peak on individual charts



A point of interest is that the maximum 2-minute peak is only 56 H.P. short of the total of the 20-minute average peaks, thereby showing that there is little margin of safety in using 20-minute peaks as a basis of billing and little diversity factor between 20-minute demands.

In view of these results, the figure of the average of the two highest 5-minute average loads taken in the same day is suggested as a billing basis for any month.

Chart 6 is an enlarged view of the combined load between 4 and 4.30 in order to determine same as closely as possible.

The last question, as to whether a load, once established, shall remain the billing basis, is an interesting and debateable one. In making a rate for a particular demand, the investment necessary to serve that demand only is a factor which must be valued. Such investment depends upon the capacity of lines, apparatus, etc., which must be purchased, and these, again, depend upon the allowable margin of drop in voltage and overload capacity of transformers which is permissible.

The margin in voltage drop is decided by the fact that the choice of wire which can be used allows only a broad factor to be obtained.

The sizes of wire vary from each other by 20 to 25%, and it is, therefore, evident that we can allow a 20% variation of maximum demand without requiring more line capacity. Similarly, transformers are not generally obtainable in sizes varying from one another by less than from 15 to 20%,

and although there is a variation in the cost per kilowatt for transformers depending on the size, this variation would not have much effect within a 20% limit. It is evident, therefore, that for the investment required to serve a customer as regards city equipment a 20% variable is allowable, because this is the nearest choice that can be made.

With regard to the permissible variation allowable in generating plant and transmission line, it will be found that almost the same factor will apply—the transmission line again can only be chosen within the limit of standard gauge. The variable in plant unit compared with total plant installed in six supply plants serving a large electric system in Eastern Canada is as follows:—

Plant No. 1	8 units.
Plant No. 2	12 units.
Plant No. 3	3 units.
Plant No. 4	5 units.
Plant No. 5	3 units.
Plant No. 6	12 units.
Total	43 units.

Average unit per plant 7—variable 14% in plant unit.

It must be borne in mind, however, that the hydraulic development has to be almost wholly completed even if all units are not installed, and, therefore, the variable is only on the machinery and equipment, and not on dams and cost of property, water rights, etc.

Taking this into account, we get the total value of plant variable as follows:—

FIXED CHARGES.

Consumer's Service	20% of $1.30	=	$0.26
Transmission Line and Transformer	20% of 2.15	=	.43
Generating Plant	14% of 4.50	=	.63
Development, say	5% of 5.60	=	.28
			$1.60

Or, approximately, 10% of $15.77.

This figure of 10% is suggested as the amount of variation which should be allowed from any established demand. Of course, individual plants differ considerably, and the best size of generating unit to install is a matter that has to be determined for each plant itself.

In conclusion, it should be stated that this paper has been particularly written with the idea of obtaining discussion on the various questions involved, as it is a consummation very much to be desired that a standard method of determining maximum demand and applying same be arrived at which will be fair to the consumer and be an adequate protection to the supply company.

THE VICE-PRESIDENT: This certainly is a very good and very important paper, but I am afraid we won't have any time to discuss it just at present, if we wish to carry out this afternoon's programme. Therefore, the discussion of the paper will be postponed until to-morrow morning.

Now, with regard to this afternoon's arrangements, it will be necessary for us to meet here promptly at 2 o'clock in order to hear Mr. Shaw's paper, "Notes on the Electrification of Steam Railways."

The entertainment feature of this afternoon is the trip to Lachine and down the rapids to Dominion Park.

Meeting adjourned at 1 p.m. to 2 p.m.

The afternoon meeting did not convene on time, so that Mr. Shaw's paper was held over till next day.

THIRD DAY—MORNING SESSION.

Friday, June 26th, 1914.

On resuming at 9.30.

THE VICE-PRESIDENT in the Chair.

THE VICE-PRESIDENT: I will call upon Mr. Ackerman to read his paper.

INTERRUPTIONS ON LONG DISTANCE TRANSMISSION LINES: THEIR ORIGIN AND MEANS OF PREVENTION.

By P. Ackerman,
Toronto Power Company, Ltd.

Long distance transmission of electrical energy has, within the last decade, undergone marvellous changes both in the applied voltage and the distance of transmission. In the rapid development higher voltages have been chosen for the new systems and we now have systems with 150,000 volt operating voltage and transmission distances of 250 miles.

With the application of higher voltages, new operating difficulties have been experienced which are due, not only to the higher voltage, but also to the larger generating capacity existing in such high voltage systems. Progressive though the Engineer has been in adopting higher voltages, yet the progress has been slow in regard to improving the reliability of operation of these systems. It is only within the last few years that the important possibilities for improvement have been realized. Now, however, strenuous efforts are being made to bring the reliability of long distance transmission to the standard of reliability of the important low voltage systems.

The object of this paper is to define the troubles affecting the operation of a transmission line and their causes, and to describe some of the problems relating to improving these unfortunate factors of high voltage transmission.

The chief troubles, their cause and effect, on the operation of a transmission line under our climatic conditions, can be grouped approximately as follows:—

(1) **Lightning Troubles** form about 80, 90% of the total number of interruptions on a transmission system. The result of lightning interference is either a puncturing of an insulator, in which case a lengthy interruption generally follows if no spare line is available; or a flash-over, in which case the insulator may be seriously damaged by the power arc.

(2) **Sleet and Wind** cause troubles from wires getting within striking distance of each other, thus causing short circuits and total interruptions. Generally no damage is done to the cables and in this case only a momentary interruption will occur. However, occasionally the power arc may burn off tie wires or cables, in the latter case causing an interruption of several hours if no spare lines are available.

(3) **Birds and Other Outside Interferences,** such as wires being thrown against transmission wires, etc., generally cause a momentary interruption without damage to the line.

(4) **Unexpected Insulator Failures,** due to puncture of insulators without apparent cause, are usually due to the observed weakening of insulators after having been in service for some time.

(5) **Short Circuits in Distributing System** sometimes cause a momentary interruption to the transmission system but without any further damage to it. This is invariably due to a non-selective straight overload protection.

The means of eliminating the troubles causing these interruptions must be sought along two general lines.

(1) Improvements of the insulators must be made to prevent any possible puncture destruction or destruction by power arc and to eliminate the observed weakening of insulators on the line.

If these weaknesses are overcome the interruptions from insulator failures mentioned in item (4) of the list will be entirely eliminated, and the durations of interruptions from lightning (item 1) will be greatly reduced and with certain devices to be described later may be prevented.

(2) Improvements on relays and relay layouts must be made to obtain such selective action that the faulty part of the system is cut out without causing a total interruption. This is necessary in case of troubles from sleet and wind, outside interferences or short circuits in the distributing system.

These two problems will be discussed more in detail in the succeeding pages.

IMPROVEMENTS IN INSULATORS.

It has been shown that lightning causes the most trouble to a transmission line and that the insulator must be considered the weakest spot. Quite often a single defective insulator will put a line out of service for several hours.

These facts have been known for a long time and a great deal of investigation work has been carried on during the past few years to clear up many of the mysteries surrounding insulator failures, and although their design has been improved and many devices for protection against power arc destruction have been proposed, there has been very little improvement in the insulator body itself.

Some may be more fortunate than others, but there is probably not an operator of a high voltage transmission line who could not tell of insulators punctured during lightning storms, or failing quite unexpectedly with no apparent reason.

It has been stated that the insulator can be damaged from lightning either by puncture through the porcelain or by the power arc flashing over the insulator. A lightning discharge near the transmission line creates an excessive over-voltage of steep wave-front or high frequency. The excessive voltage is very often higher than the voltage the line insulator withstands and the result will be the breakdown of the insulator nearest the lightning discharge, the over-voltage thus finding release to ground. If one phase in a grounded system or two phases in an ungrounded system break down simultaneously, then a short circuit is produced between phases and an excess current will flow across the insulators which arced to ground and normally a total interruption is required to extinguish the arc across these insulators.

If the insulator requires a considerably lower voltage to flash-over through air than it takes to puncture straight through the smallest thickness of porcelain existing between live wire and pin, the lightning surge will

flash around the insulator with the dynamic current of the system following and forming a heavy arc. If, however, the voltage required to puncture through the porcelain is smaller or about equal to the flash-over voltage, then puncture will occur—that is, a small hole will be pierced through the porcelain from live wire to pin and the power current will flow through and will generally destroy the insulator. Puncture of an insulator is the most serious condition, as it will put the line out until the fault has been located and the insulator replaced, which frequently requires several hours.

DANGER OF CABLE BURN-OFF.

In designs where the line wire is directly supported on a porcelain head and where such head may have a tendency to puncture, the situation is aggravated by the danger that the cable may be burnt off. Some observations and tests made by the writer may be mentioned to show the seriousness of this condition.

On an ungrounded system a ground on one phase was noticed. About two minutes later the line was cut out, no short circuit had occurred. Upon inspection a line wire was found burnt off and the insulator head was found to have a puncture hole right in the saddle where the line wire was resting. It seemed at first hardly believable that the charging current of 6 amperes of the line wire to ground could have burned a 4/0 line cable through within approximately two minutes; however, since no other explanation could be found, it was decided to demonstrate this action by a test.

A punctured head was obtained and a line wire seated above the punctured hole. A 12,000-volt generator with a water rheostat in series with the puncture hole of the disc was adjusted to about 80 ampere current flow, this being the lowest possible adjustment. The discharge through the puncture hole had to be started by a thin fuse wire pushed through the puncture hole. With this adjustment the oil switch of the generator was closed in, starting the 80 ampere discharge through the puncture hole. Instantly a concentrated flame shot out of the puncture hole and within three seconds the 4/0 cable was burned in two.

Comparing the test result with the observed action on the line it will be noticed that in the test a current about 13 times larger than in the case of the ground on the line did the same destruction within about one-fortieth of the time and, therefore, the test may be considered a satisfactory explanation. The effect is evidently due to great concentration of energy at the point of puncture, since it must be understood that any puncture hole will, the instant when formed, be smaller than a needle hole and thus concentrate the whole discharge at this point.

It will now be understood why in case of an actual short circuit on a line, where not only 6 amperes, but possibly several thousand amperes may pass through the small puncture hole, the momentary destruction is enormous, and it may be easily understood that in such cases the punctured insulators or discs may actually burst apart and line cables seating on them burn off notwithstanding the fact that there may be instantaneous relay action. From this it may be concluded that line wires should not be supported directly on porcelain unless one can be absolutely sure that the porce-

lain is non-puncturable. It is safer to have a design having the cable supported away from any point of possible puncture.

Aside from the serious trouble just mentioned, the puncturing of an insulator will tend to cause long interruptions unless replaced, since the puncture hole will form such a short air path between live wire and ground that it may break down at normal operating voltage.

ROUTINE TEST GUARANTEEING PORCELAIN OF EVEN ELECTROSTATIC QUALITY.

It has been previously mentioned that in order to obtain a non-puncturable insulator the puncture voltage must be considerably higher than the flash-over voltage of the insulator. The flash-over distance may be considered as a sort of safety valve for the porcelain—the lower it is set the better the porcelain will withstand any strain it is subjected to, since it will bring relief before the breakdown voltage of the porcelain is reached. How high this ratio of puncture to flash-over should be, not to overstress the porcelain for the steepest wave front or the most severe high frequency, is not definitely known, but experience shows that it should be at least 1.5:1 and preferably 2:1.

In the search for a commercially possible routine test which would assure an even product, a ratio of puncture to flash-over of at least 1.5:1, it was determined that a flash-over test of a sharp pronounced high frequency nature was considerably more severe on insulators, even if only on for a few seconds, than a test of any duration near but below flash-over point. Further, it was noticed that the longer a continuous sparking-over continued the more discs were punctured. These observations led to the suggestion that a certain relation existed between the duration of application of the high frequency spark-over and the ratio of puncture to flash-over. A comparative test was made on a large number of discs, subjecting the discs first to a two minute flash-over of absolute continuity and thereafter determining the puncture value of the discs which withstood the test by puncturing them under oil. The result was that all discs which withstood successfully the two minute flash-over test, had a puncture value which was 40% higher than the flash-over voltage. This relation between time of application and minimum necessary ratio of puncture to flash-over may be different on different test sets, depending upon the characteristics of the whole test arrangement. In a general way, however, it may be said that the ratio will be increased as the short circuit current on the test transformer is choked down. This will be more clearly understood by studying the oscillogram of such spark-over. Fig. 1 shows the oscillogram of the high and low tension voltage of the testing transformer during discharge over an insulator. Fig. 2 gives the diagrammatic connections of the oscillograph to the test circuit. This oscillogram indicates clearly that the flash-over test is more severe than an ordinary test below flash-over, since in case of the flash-over test severe high frequency oscillations are obtained. An explanation of the oscillogram may be given as follows:—The high tension winding of the transformer has a certain electrostatic capacity: If now the momentary voltage impressed upon the insulator, gradually rising from zero, is reaching

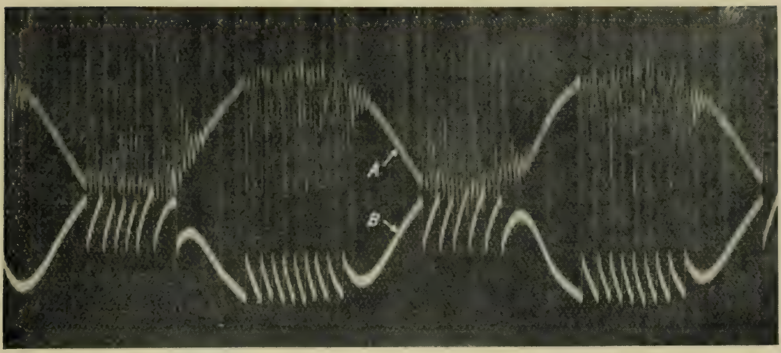
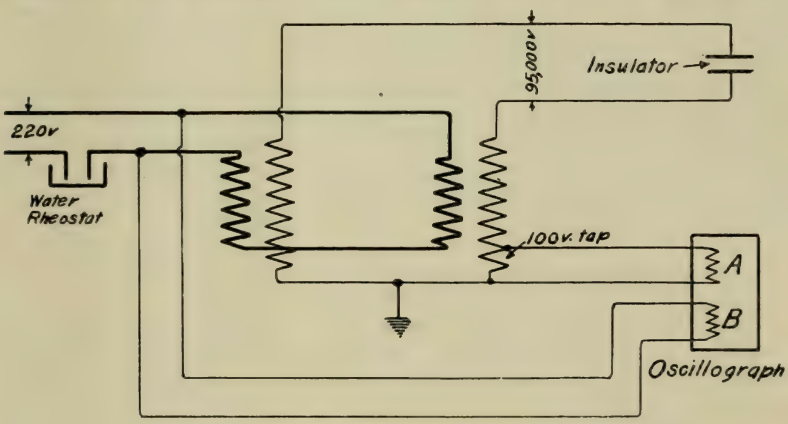


Fig. 1—Oscillogram on a testing transformer, showing discharge over insulator of 95,000 V. flash-over.
(A)—High tension voltage. (B)—Low tension voltage.

the flash-over point of the insulator, a short circuit current will flow over the insulator. The current will be composed of two super-imposed currents, one being the low frequency current of the energizing power system, the other the transient discharge current of the short circuited electrostatic capacity of the transformer. The transient capacity current will rapidly



DIAGRAM, SHOWING CONNECTIONS OF OSCILLOGRAPH TO TESTING TRANSFORMER

Fig. 2.

diminish to zero in the form of a damped oscillation, and will, therefore, not be able to maintain the arc over the insulator when reaching zero point. The low frequency power current, however, would ordinarily be heavy enough to maintain the air broken down, although the voltage may have dropped to zero. Therefore, if the arc is to be extinguished after the transient discharge has occurred, it is essential that the power current be choked down to a very low value. This has been the case in the test shown on

oscillogram of Fig. 1. The result was that after the first transient discharge of the capacity was completed, the arc was completely extinguished and allowed the potential to build up again and charge the whole electrostatic capacity of the transformer winding and the insulator. The instant the flash-over voltage was reached again the insulator arced over again and repeated the oscillatory condenser discharge, this phenomena being repeated on each half cycle until a point was reached on the fundamental half wave which was not high enough to flash-over the insulator and starting again when the flash-over voltage is reached on the next half wave.

The number of discharges per half cycle are governed largely by the test arrangement, but can be forced by keeping up the voltage on the low tension side. This oscillogram and the mentioned test results indicate clearly the way to a routine test which should guarantee an electrostatically even, sound porcelain. This can be assured by specifying a flash-over test of absolute continuity of several minutes' duration with a test arrangement having the power choked down. This is normally indicated by a clean pronounced, sharp crackling high frequency discharge.

WEAKENING OF PORCELAIN WHILE IN OPERATION ON LINE.

One problem, however, remains to be solved even after the means are available for procuring an insulator withstanding puncture when first put up on the line. It has been the experience of most power companies that a slow weakening of the insulators occurs after having been in service for some years, and that insulators which may have stood any kind of flash-over may, after some time, puncture even at normal voltage. No definite answer has been given as yet to this observed weakening and no absolute remedy determined. However, we can hope that this matter may be cleared up in the near future, since it has been receiving the attention of both manufacturers and power companies.

DESTRUCTION OF INSULATORS FROM POWER ARC.

With the insulators made non-puncturable, a lightning discharge will flash-over the insulator and cause an excessive dynamic current to follow, developing a so-called power arc with its attendant heat, endangering the porcelain.

The effect of such a flash-over may, under certain conditions, be as destructive as a breakdown due to puncture. There are, however, more possibilities for safeguarding against this action.

Some investigations made by the writer may give a clearer understanding of the points which must be taken into consideration in determining a means for preventing power arc destruction.

To determine the resistance of certain insulators against heat destruction from power arcs, some tests were made on two types of insulators as shown in Figs. 3 and 4, both being in use on a 60,000 volt line. A 10,000 Kw. generator was used to provide a discharge over the insulator at a current rate of 300 to 500 amperes. The arc was started by means of a very thin fuse.

Figs. 5 and 6 show the destruction obtained in various tests. The pictures are self-explanatory, readily showing the destructive effects of a power arc of several thousand amperes on the line even though the arc be interrupted by instantaneous relays. Comparing the results with the two different types of insulators, a conclusion may be drawn in regard to the general principles which have to be considered in the design of insulators to better resist destruction from power arc.

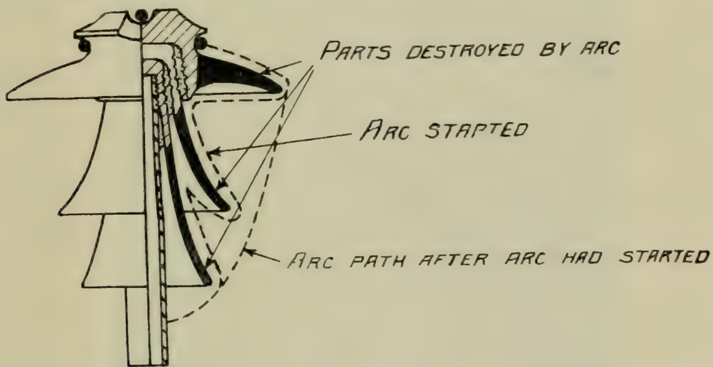


FIG. 3.

Fig. 3 is one of the old type insulators with very long petticoats of thin wall-thickness. The hot vapours of the arc are caught in the deep pockets, resulting in the breaking up of the petticoats; the small wall-thickness reduces the resistance to heat destruction.

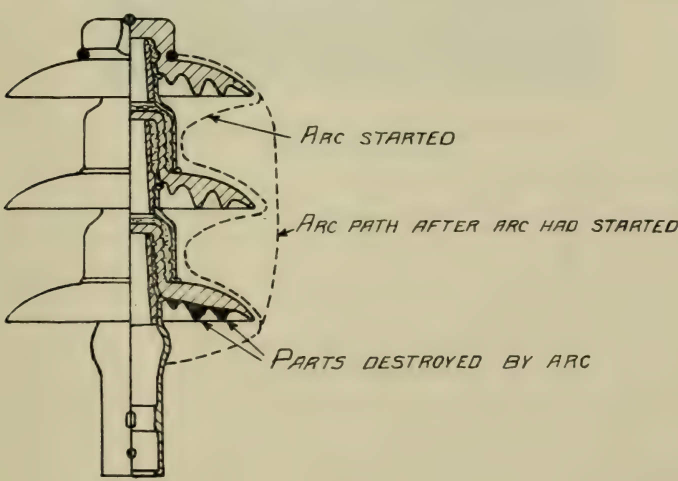


FIG. 4.

Fig. 4 represents a new type of insulator built according to the general principle of the suspension insulator. In regard to resistance against power

arc destruction, it has the advantageous features, however, of having heavier discs and a shape allowing the vapours greater opportunity to escape. The effect of these features can be noticed by the small destruction indicated in Fig. 4 and Fig. 6, where the corrugation of the bottom disc only broke off without affecting the insulating quality of the whole insulator.

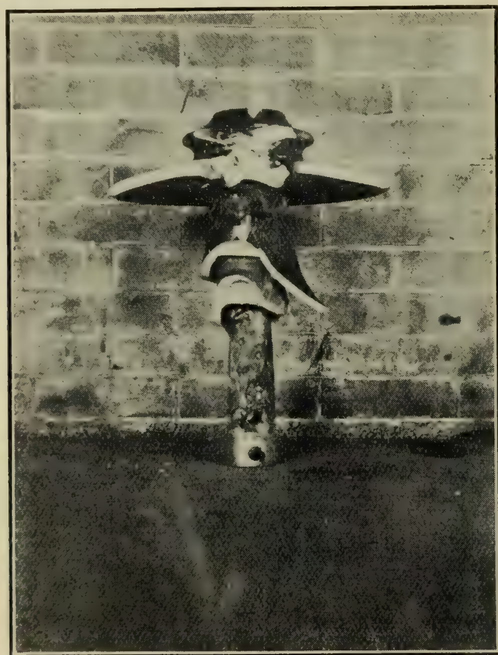


Fig. 5—Insulator destroyed by 500 amperes power-arc of five seconds' duration.

Recognizing the impossibility of preventing flashing-over over the insulator from lightning surges, and on the other hand recognizing the destructive action of the power arc, a device was considered which would deflect the arc away from the insulator before harm could be done to same. Several such devices are known and some have been in use for several years. However, most of them are so designed that the arc will generally stay at one point on the cable or tie-wire and thus fuse them off. The horn as shown in Fig. 7, therefore, was designed with the object of producing a natural tendency for the arc to follow the line wire and not to rest at any point. The result was very effective, as is indicated in Fig. 8. Arcs were started by a thin fuse on different sides of the insulator and with wind action from different directions. About a dozen discharges were made in still air as well as in wind, and all that could be noticed on the line cable or tie wire were very light surface spots, the arc being carried with great speed along the line cable. It was particularly interesting to note the easy movement

of the power arc and its great sensitiveness to the slightest air current. This horn was never tried out in practice, not because its practicability was questioned, but because another apparatus was then decided on which made any need of an insulator arc protector unnecessary. Some mention may be made of this latter development.

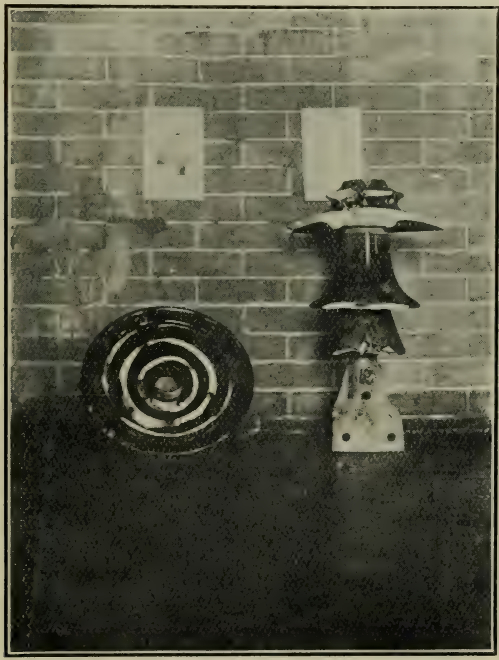


Fig. 6—Insulators destroyed by 400 amperes power-arc of five seconds' duration.
(1)—Three-petticoat insulator.
(4)—Bottom disc of disc-type insulator. See Fig. 4.

All the features thus far mentioned have tended to improve and protect the insulator in order to prevent serious long interruptions to transmission systems; however, none of them will prevent momentary interruptions. Nicholson's arc extinguisher goes one step further and attempts to avoid even the interruption. It is based on the following principle: The instant an arc-over and the resulting short circuit occurs at any point on the line an overload relay located at the generating station will close an artificial short circuit through high tension fuses; this metallic fuse circuit will draw all the current away from the insulator, thus allowing the air around the insulator to establish new insulation. Meanwhile the fuse will blow and rupture the artificial short circuit. This whole process completes its cycle within a fraction of a second, and the result is that the voltage of the system will merely be disturbed for a short time and in a manner similar to a short circuit separating itself selectively from the main system.

Synchronous machines may drop out of step if of low synchronizing power; however, lighting and induction motor power will observe a momentary flicker only. The device is decidedly a lightning protection, while

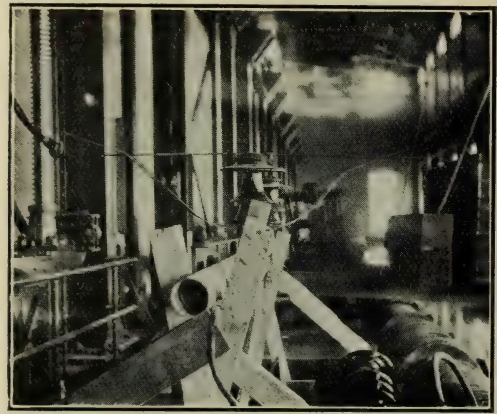


Fig. 7—Horn arrangement used as power-arc deflector.

for wires swinging together, or for shorts due to outside interference, it will probably not be effective, since the fuse will blow too quickly and allow

Fig. 8—Power-arc started over insulator and deflected by horn.

the arc at the point of trouble to re-establish again; however, since lightning troubles are by far the most numerous ones, we can be assured that this new

method of keeping uninterrupted service over a long distance transmission line has considerable value. The first requirement for its success, however, is the absolute non-puncturability of the insulator.

In the foregoing mention is made of the characteristics of an insulator to reduce line interruption to the shortest possible time, and a device has been described which will prevent interruptions in case of insulator flash-over if the insulator has the proper characteristics of non-puncturability and non-ageing.

From the list of interruptions it can be noticed that with such improvements hope can be entertained of safeguarding against 80 to 90 per cent. of our line interruptions.

SELECTIVE RELAY PROTECTION.

Interruptions from sleet and wind, outside interferences, or short circuits in the distributing system are of such a nature that their prevention must be obtained by a proper selective relay protection, cutting out the faulty part only, without interrupting the main system.

The relay problem is very complex and can only be worked out with full knowledge of a system. Its importance has been recognized only within the last few years and it is only lately that a marked forward step has been made. The design of a relay layout is so largely depending upon the nature of each system that it is difficult to draw up any general rules, and for this reason only a few essentials are discussed.

SELECTIVE STRAIGHT OVERLOAD PROTECTION.

Fig. 9 represents the single wire diagram of a simple transmission system. The purpose of selective straight overload protection is to safeguard against total interruptions due to local troubles in the distributing system.

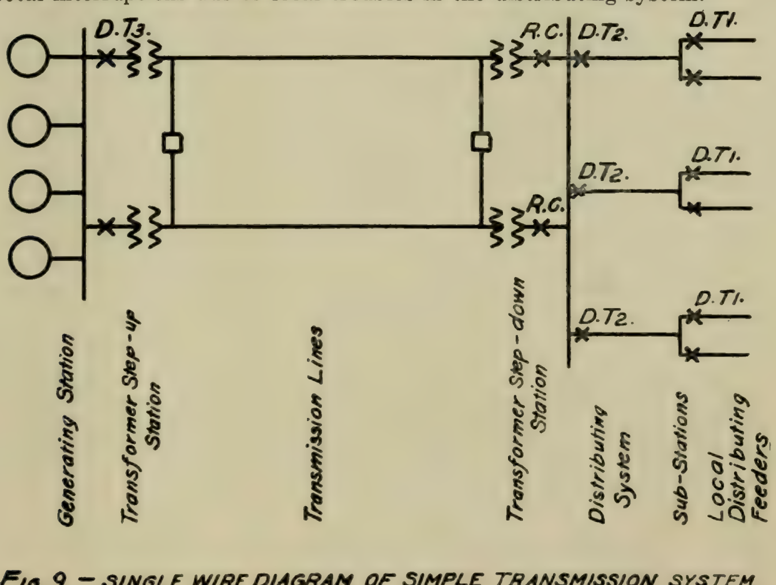


FIG. 9. — SINGLE WIRE DIAGRAM OF SIMPLE TRANSMISSION SYSTEM

Assume, for instance, that a short circuit in one of the local distributing feeders could be cut off the main system by its own feeder switch without interrupting the whole sub-station, or, again, that a trouble in one of the sub-stations might clear itself from the main system without interrupting the main system.

This protection requires such characteristics of the relays that they will open the switch nearest to the short circuit before any switch nearer the generating station can open.

Until a few years ago this selective action was attempted generally by inverse time overload relays; devices were set to trip at a certain overload current within a certain number of seconds; the characteristic of those relays was that the greater the short circuit current the shorter the time element became. The decrease in the time element, however, was so rapid that at a current flow of about two times the current setting—that is, the current at which the relay started to actuate—the action of the relay became practically instantaneous. The result was that not infrequently, due to a heavy short in one of the distributing feeders, where the excess current in the main system reached abnormal value, not only the respective feeder switch tripped, but also all of the switches back to the generating station, thus causing a total interruption. It was attempted to obtain selective action by setting the local distributing feeders for three seconds, the sub-station feeders for six seconds and possibly the lines at the generating station end for nine seconds, but with a heavy short circuit passing through all three settings were practically instantaneous and accordingly all switches tripped simultaneously From this it will be understood that the first requirement to obtain a selective overload protection is a definite time characteristic for the relay on heavy short circuits—that is, it will require a certain definite time to trip the switch, no matter how heavy the short circuit current may be. With such a relay characteristic the local distributing feeders may be set with a certain time element D.T. 1, the sub-station feeders with D.T. 2, and the generating station switches with D.T. 3, (1) indicating the shortest time element, (3) the longest one, and having such intervals between the three switches that for the heaviest short circuits the switch nearest the short circuit has time to cut the short off before the next switch is actuated. In addition to this first necessary characteristic of the selective overload relay, two other vital characteristics are accuracy and reliability, otherwise the wrong switches may act and may thus impair the selectiveness. The higher the accuracy and reliability the closer successive switches can be set.

So-called definite time relays have been on the market for a number of years, but it is only recently that relays have been devised which combine all three necessary characteristics mentioned above, and it is for these reasons that it is only lately that successful selective, straight overload protection has been obtained.

SELECTIVE OPENING OF A FAULTY MAIN LINE.

This problem is extremely difficult and has thus far not been solved satisfactorily. Present practice is to provide reverse energy relays at the distributing ends of the lines which are supposed to trip the instant the energy flow into the line reverses. Such reversal of energy always occurs on a faulty line on the far end, since current will feed through the good line and the sub-station at the far end back into the faulty line. These reverse energy relays are invariably built on a principle of such interaction between a potential and a current coil that with energy flow in the normal direction the relay contacts are kept open, while upon reversal of energy flow the relay contacts will close. These relays will usually be very accurate on normal voltage. However, on very low voltages some of them will not act at all, like a wattmeter with the potential coil disconnected, or others will act on straight overload. Since, in the case of a short circuit on a line the potential may drop almost to zero, it will readily be understood that relays of such characteristics will lose their selective reverse current feature, and it is quite common experience that their selective action is so unreliable that they cause total interruptions. This is particularly the case where the reverse current protection is put on lines which are tied together on the high tension side, since the short circuit current will then pass from one line to the other through the high tension bus, so that the low tension voltage from which source the relay is invariably energized will drop to zero.

The selective action of the reverse energy relay can be improved where the conditions permit operation of the two lines with the high tension side sectionalized, thus forcing a short circuit current from one line into the other through the transformers and the low tension bus. This will have a tendency to keep some voltage on the low tension bus. However, even with these operating conditions, selective action of reverse energy relays can only be obtained when a relay will trip on very low voltage and power factor; and further, the impedance of the step-down transformers must be comparatively large to maintain sufficient voltage for energizing the relays. Unsatisfactory as this reverse energy relay has proven in the past, no better solution has yet been proposed as far as the protection of two parallel lines is concerned.

The Merz-Price system, which is successfully applied for cable and transformer protection and short distance overhead distribution, is on long distance transmission lines meeting with considerable technical difficulties. Further, it would be rather expensive, since pilot wires would have to be strung between the two ends of the line.

Selective protection of three or more parallel lines can be obtained by taking advantage of the fact that, whenever a short occurs in one line, the current balance in the respective phases of all parallel lines becomes disturbed. Schemes along this line may probably find some application in the future. They will be rather complicated in the wiring layout, as they will require interconnections between the current transformers of the parallel lines; but they will undoubtedly prove very effective, since the

troublesome potential element is eliminated so that the heavier the short circuit the more positive the action of the relay.

From these notes on relays it will be observed that a large field for improvement is still open and considerable development is necessary before suitable relay protection for troubles on transmission lines by selective action is obtained.

In conclusion, it may be said that successful efforts are being made to improve the reliability of operation of long distance transmission lines and that hope can be entertained that the insulator problem will be solved at least to such a point that the chief causes of present transmission line troubles will be eliminated, and that with some further development in relays such selective action may be obtained that total interruptions will be safeguarded against.

DISCUSSION.

The Vice-President: The subject of this paper is the most serious problem that an operating engineer has to face just at present, and I trust that we will hear from representatives of some of the power companies that are here to-day in the discussion in regard to it.

Mr. Wills MacLachlan: Just to open the discussion I would like to ask Mr. Ackerman, from his experience in regard to insulators, if he would consider there is a possibility of fatigue in the insulator with regard to its insulating quality, such fatigue possibly being the reason for the number of insulators that have broken down in the high-tension lines in Ontario in the last year and a half.

The Vice-President: Are there any representatives here from the Light, Heat and Power Company and Shawinigan Water and Power Company, who have any contributions to make to the discussion? I suppose all are so busy looking after our entertainment that they have not time to attend the meeting.

Mr. S. B. Hood: In connection with Mr. Ackerman's paper, which I am sure has fairly covered the ground, there are several points that have occurred to me. One is in connection with the insulator. I would like to ask Mr. Ackerman if anything is being done similar to what Mr. MacLachlan has already asked in reference to the fatigue of insulators and whether they have discovered what the real cause of it is. Now, from insulators which I have had to deal with, apparently the breakdowns are all of mechanical origin. In other words, apparently if we are going to cement a metal pin in an insulator, it is simply a question of time when that insulator is going to break. It may be a week, a year or ten years, but it is a foregone conclusion that sooner or later it will break. That, as I size the situation up, is due to the greater expansion of the iron pin in proportion to the porcelain under heat. In other words, the pin will expand and strain the porcelain. When the pin contracts the porcelain will not contract with it, but rather takes up a permanent strain, so that on contraction there is a slight space left between the pin and cement which appears to fill up with corrosion, so that the next time there is expansion you are simply increasing the strain on your porcelain. So, after a certain

number of these expansions and contractions, it means that the insulator is going to go down. I have had quite a number of 26,000 volt strain insulators which have gone down on 2,300 volts. Only a week ago I had two that went down the first time they ever had a potential across them, showing that the failure must have been of a mechanical nature, not electrical.

Another point that occurred to me is the question of arranging some kind of horn gap relief valve on all insulators, which I think I have brought out off-hand in the report of the Overhead Standardization Committee. If we can make the relief portion of our system fairly independent of the insulator there is no reason that I can see why insulators should be subjected to strains from arcs flashing over.

In connection with relays, I can quite agree with Mr. Ackerman that the inverse time system of relays is absolutely useless. They are all inverse until you get a short circuit, and then they are all instantaneous. I think the only place for an inverse time element relay is on the outgoing distribution system. For the transformers the differential type certainly appeals to me. In fact, I think a differential relay could be used much more frequently in this country than it is. What I can learn of the foreign system, particularly the English system, the Merz-Price is almost standard and apparently they have no interruption to their distribution, none of those accidental interruptions that have no excuse, such as we have with our relay system.

Mr. Kerr: I am afraid, Mr. Chairman, I will just show my ignorance of the whole matter. I was going to ask a question in connection with this experiment on page 5 on the cable burn-off. The paper tells us that with the current 13 times larger the time required to burn off the cable was one-fortieth. Now, according to the rule the time would be, even suppose it were universal, proportionate to the amount of heat development, about one-one hundred and seventieth, and I do not know whether we would be justified in considering that inverse law correct. It is a matter rather of the temperature than the amount of heat developed, is it not?

Mr. Ackerman: I believe an explanation of that is, that just the volume of copper is melted off which lies above the puncture hole. Therefore, the larger the puncture hole gets, the larger the volume of copper above the puncture hole which has to be melted off with practically the same heat energy.

Mr. Kerr: Did you measure the time very accurately?

Mr. Ackerman: No, we just measured it approximately with a stop watch, the instant the arc started to the instant the arc was off. It is only comparative. In regard to the time of 1½ to 2 minutes we cannot tell exactly neither just at what point the wire went down. It was surely below 2 minutes and we did not have it only in one case, we had it in two cases. Naturally you find when you start up a line you have some bad insulators.

The Vice-President: I wonder if Mr. Ackerman has had any experience with series trip coils on high voltage system ?

Mr. Ackerman: Frankly, I have not. Does that mean for higher voltages or for lower voltages?

THE VICE-PRESIDENT: Say for 30,000 volts.

MR. ACKERMAN: I never had a chance to look into that, but I should think where you want to get instantaneous action and accordingly a simple relay, it should be all right. However, where time limit is required, with a relay which needs some attention, it would not be very desirable to use a series trip coil submerged in a tank out of sight. But this is merely just what occurs to me; I really have not had any experience with it.

THE VICE-PRESIDENT: There are certainly a great many series trip coils used on high voltage which have not given satisfaction.

MR. ACKERMAN: I should think that would be a matter of having it well protected away from any arc.

A DELEGATE: From the commercial point of view, to show the value of Mr. Ackerman's investigations and the work that our engineers afterwards did after these investigations took place, I might mention that our company, the Toronto Electric Light Company, is now getting what we consider considerably more than our share of the business, and getting it at figures varying from 15 to 30 per cent. higher than our competitors. I think that is due solely to the class of service that we are able to give. That is due greatly to the work that Mr. Ackerman has done along those lines.

THE VICE-PRESIDENT: If nobody else has any further discussion to offer we will ask Mr. Ackerman to reply.

MR. ACKERMAN: Mr. MacLachlan and Mr. Hood were bringing up the point of fatigue. It is rather a hard matter to talk these points over, and I cannot practically say anything but just a personal opinion, because it is something which is not absolutely understood yet. But as Mr. Hood mentioned—it is an absolute sure thing that it happens. I have mentioned already some general beliefs along the line of fatigue. Personally, I think we have to consider two different kinds of fatigue. One is molecular fatigue. I consider that similar to the weakening of a spring which is under constant vibration. We know that a steel spring, if it is not used under vibration, can ordinarily be stressed up to a very high point, almost near its elastic limit, without harm or without breaking quickly. If we stress this spring up to the same point of mechanical stress when it is in use where it continuously vibrates, this spring might go down very rapidly. This is what we consider the molecular fatigue, the loosening of molecules in the spring causing the final breaking off. In order to let that spring stand up for a considerable time we have to put a very much lower value of stress on. And the interesting thing is that we come to a certain limit. If we stress it above this the spring has a very short life: let us say, perhaps only a few days or so. If we go just below that point the spring might stand for years.

Now, to go back to the insulator, I believe there is a possibility of very similar action. With alternating current we have continuous electrical vibration which practically starts a mechanical vibration of the molecules due to the constant change of the potential on the insulators, from a certain plus value to a certain minus value. We might compare that with the vibrations of the spring which continuously moves from one side to the other. If this insulator is operated at a voltage comparatively high, pretty

close to the puncture value, this insulator might finally break down; the molecules might fatigue just as in the spring.

Similar to the spring, therefore, we will have to operate the porcelain at a certain voltage below puncture value in order to prevent fatigue; that is, we have to operate with a certain safety factor.

A short mention of some tests made last year may show more convincingly that such molecular fatigue evidently exists where the porcelain is stressed at too high a voltage, leaving a too low safety factor.

In connection with the tests for which the oscillographic study is shown in the paper, we had a bunch of insulator discs made of very uneven porcelain, the puncture value of which was varying, from 100,000 to 140,000 volts. The flash-over value of the insulator was somewhere around 100,000 volts; therefore, the safety factor at flash-over voltages ranged from 1 to 1.4, most of them being nearer to 1.

When testing those insulators for two minutes flash-over with the test arrangement as described in the paper, we were able to puncture almost 90% of them; the insulators which withstood the test showed all a puncture value of at least 140,000 volts, that is, a ratio of puncture to flash-over of at least 1.4. This excessive loss was evidently due to molecular fatigue, due to the fact that the applied voltage stress was too near the puncture voltage, and the test showed that evidently only those insulators were able to withstand the two-minute application which had a safety factor above 1.4.

In order to prove this another test series was made with the same kind of insulators, but with the flash-over voltage artificially reduced to about 70,000 volts. This test was made with the same test arrangement, and the result was that only about 10 to 15% of the insulators were lost; the insulators which withstood in this test the two-minute application showed a minimum puncture value of approximately 105,000 volts; that is, a ratio of puncture to flash-over of 1.5. This result, therefore, checks with the previous test.

The explanation of these two test results may be given as follows: The two-minute test with our testing transformer requires evidently a ratio of puncture to flash-over of at least 1.4 to prevent molecular fatigue. Most of the insulators had a puncture value of only 100,000 volts to 130,000 volts; therefore, with a flash-over at 100,000 volts they were not able to withstand the test application; however, as soon as the flash-over was reduced to 70,000 volts, thus increasing the ratio of puncture to flash-over above the necessary safe value, the same kind of insulators withstood successfully the test application. These tests should show convincingly the existence of molecular fatigue and the necessity of a proper safety factor to prevent such fatigue.

Now, these mentioned tests give an idea of the safety factor required for flash-over conditions in order to prevent molecular fatigue. However, as known, insulators will be stressed to flash-over voltage in case of lightning and then for fractions of a second only; while during normal operation the safety factor will be much greater. For instance, the insulator disc mentioned in the test will, under normal operating voltage, operate at 14,000

volts exceptionally up to 20,000 volts, while the puncture value is approximately 140,000 volts; that is, under normal operation the insulator is working at a safety factor of from 7 to 10.

The question arises whether the observed weakening of insulators during normal operation may be explained by molecular fatigue too, or whether other factors may be responsible; or, in other words, whether possibly the safety factor of 7 to 10 may still be too small to prevent molecular fatigue for an insulator which is subjected to this stress for years continuously. This question cannot be answered definitely, since the fact that a safety factor of 1.5 was sufficient to stand a severe test strain for several minutes is no direct proof that with a continuous application for years a safety factor of 7 may be sufficient. Yet personally I feel certain that such is the case, and that, therefore, the weakening of insulators from normal operation must be caused by something else besides molecular fatigue; something we do not know exactly yet and which is probably due to a combination of different causes.

Mr. Hood mentioned that insulators go down mechanically. I think that is one point. And it seems to me often that it is a pity we do not find some other material which could stand better shocks than porcelain, for use on high-tension lines. I think we should have an elastic material, because, no doubt, an insulator out on the line is continuously under mechanical vibration, and we know that insulators, particularly under a certain load, stand hardly any shock. They crack; they might have internal stresses already when they were fired and only a small blow might be sufficient to cause a crack. That is no doubt probably one reason why insulators go down.

Mr. Hood mentioned another point; in regard to expansion of steel pins in porcelain insulators; that is, uneven expansion between porcelain and steel. That might be one reason why porcelain might mechanically fail and finally puncture, but I am less certain on that point. I want to ask Mr. Hood whether he had noticed any difference between wood pins and steel pins in insulators?

Mr. S. B. Hood: Always in the steel pin; never saw any trouble with wood. Apparently the wood will compress itself and relieve the strain on the porcelain.

Mr. Ackerman: Don't you think that wood, due to its much higher elasticity, might help to take up the shocks which come on to the insulators, apart from the effect from heat expansion?

Mr. Hood: Below 25,000 I think practically all insulator failures are due to mechanical defects.

Mr. Ackerman: That could be one explanation. We have made some investigations along these lines, although they were not very thorough. We took some insulators and put them from cold water into hot water and back again, using water up to boiling point, and we could hardly find any mechanical effect. Of course, if such abrupt changes were kept up continuously for years perhaps we might get something. There is some possibility that moisture might have some effect on porcelain, but investigations so far have not absolutely developed how far that might be right.

Then Mr. Hood mentions the horn relief gaps for insulators. Without arc extinguishers I would say that the horn gap would be very desirable. However, on low voltage distribution the horn gap may be less required, since we have mostly insulators which stand more heavy arcs, the porcelain itself being thicker comparatively, compared with high-tension insulators, and for this reason I believe low voltage insulators do not fail often owing to flash-over. I might ask Mr. Hood if I am right in that or not?

Mr. Hood: Below 25,000 I think practically all insulator failures are due to mechanical defects.

Mr. Ackerman: The horn gaps are practically of more value for high voltage insulators.

In regard to relays, I agree with Mr. Hood that the Merz-Price system should be used much more over here than it is. It is for cable and overhead distribution on lower voltages and on smaller scale; for a few miles only it is extremely effective. It is very extensively and very effectively used in England.

The Vice-President: The next paper is one that had to be postponed from yesterday afternoon. It is a paper by Mr. J. A. Shaw, Chief Electrical Engineer of the Canadian Pacific Railway.

SOME NOTES ON STEAM RAILWAY ELECTRIFICATION.

By J. A. Shaw,

Canadian Pacific Railway Company.

The determination of the preferable system for electrifying a section or branch of a railway, involves that best adapted for general service. If successful, the installation may be extended as electrification of other portions of the road may prove desirable. This will depend on the success obtained in economical and reliable operation. It is necessary in view of further extensions to select a system suitable for general conditions to obtain interchangeability in rolling stock. Possibly different systems may be used on different parts of a road, but each will have to operate under all conditions on the district on which it is installed.

SYSTEMS AVAILABLE.

Three systems now exist which include all which need be considered in view of the present state of electrical development. One, the three-phase alternating, is not suitable for general electrification, on account of requiring two trolley wires, with the resulting complications and the peculiar characteristics of the motors employed. The remaining two systems are single-phase alternating current, and the 2400-volt direct current.

The single-phase system has been used in the electrification of the New York, New Haven and Hartford Railway from New York to Stamford, and is now being considerably extended. It has also been used on a number of light railways, notably the Spokane and Inland. Abroad it is in use on the London, Brighton & South Coast Railway, the Swedish State Railway and others, and has been adopted by the German, Swiss and Austrian State Railways as their approved system, although it cannot as yet be considered as completely through the experimental stage.

The 2400-volt direct current system is a development from the 600-volt system, which is practically the standard in all street railway and interurban work, and which has been so successful on that field. The electrification of the New York Terminals of the New York Central and the Pennsylvania Railroads, the Atlantic City Line of the Pennsylvania, the New York Subway, and all elevated railways have also employed this system. Abroad it has been used on the Lancashire and Yorkshire Railway and in general under conditions similar to those in this country. During the past three years a number of light railways have been installed using 1200-volt direct current, in most cases, however, using 600-volt motors, and from the experience obtained, the 2400-volt system has been developed, using 1200-volt motors, and this system has now been in use on the Butte, Anaconda and Pacific Railway, preparatory to a further use of it on two divisions of the Chicago, Milwaukee and Puget Sound Railway, for the past 10 months. A lower voltage installation at 1500 volts has been in service over three years on the Piedmont Railway in South Carolina.

SUPPLY OF POWER.

It is possible that in the majority of cases for years to come that power will be generated for locomotive purposes alone, without considering its use for other purposes. However, electrification will be made possible more through cheap power being available from existing power plants, where if a separate plant had to be erected it would be too expensive. Possibly in the future power plants will be constructed at points where commercial power is not available, but even in that case at other points on adjoining divisions commercial power might be obtained, and to permit of uniform equipment the power generated would either have to be uniform with that purchased or the latter converted to the character required. Throughout the West and in the Montreal district, 60-cycle, three-phase transmission is practically universal, and while 25-cycle, three-phase current is employed on the Hydro-Electric and Toronto-Niagara transmissions from which 25-cycle single-phase could be obtained by stationary transformers, balancing apparatus would be required. In view of the tendency to use 15-cycle in place of 25-cycle current in single-phase electrification and the remoteness of general electrification in Ontario, it is reasonably safe to assume that converting apparatus will be required for either single-phase or direct-current installation. The application of 15-cycle generators in 60-cycle power stations or of frequency changing apparatus to furnish single-phase current, while possible, does not actually change this assumption, as the increased price asked for by the power companies equals the cost of conversion by the railroad in addition to requiring the erection of separate transmission lines.

GENERAL ARRANGEMENT.

The general arrangement of the two systems may be outlined as follows:—

Single Phase.

A 1. Power line of supply company.

A 2. Conversion station at one or two points per division furnishing single-phase current from motor-generator apparatus and step-up transformer for raising potential.

If power lines are available at several points on division, number of conversion stations may be increased, and length of transmission lines correspondingly reduced.

Direct Current.

D 1. Power line of supply company.

D 2. Transmission line to substations. Where supply company power lines are available at several points on division, sub-stations may be conveniently located at such points, and length of transmission line correspondingly reduced.

A 3. TRANSMISSION LINE from conversion stations to transformer stations.

A 4. TRANSFORMER STATION in which high voltage single-phase current is transformed to 11,000 volts for trolley line.

A 5. TROLLEY LINE AND BONDING.

A 6. ELECTRIC LOCOMOTIVES OR MOTOR CARS.

D 3. SUB-STATIONS in which three-phase power is converted to direct current by motor generator apparatus.

D 4. FEEDER LINE by which direct current is supplied to trolley line.

D 5. TROLLEY LINE AND BONDING.

D 6. ELECTRIC LOCOMOTIVES OR MOTOR CARS.

COST OF INSTALLATION.

An inspection of above table shows that as a general proposition certain of the items are practically common to both systems. Transmission lines A-3 and D-2 will be required for the entire length of the division if power were received at one point: whereas if power were received at several points, while several single-phase conversion stations could be installed, that would not prove practically economical, and with direct current there would be a saving in the transmission line required. The transmission line for single-phase current costs 20% more per mile than that for three-phase, so that it is entirely fair to the single-phase to consider the cost of transmission lines equal.

The trolley line and bonding are practically the same. For single-phase, higher insulation is required on account of the higher voltage and the surging which occurs. With the improvements that have been made in the manufacture of insulators, the difference would not exceed 10% of the cost of the trolley line.

The conversion stations and transformer stations A-2 and A-4 for single-phase, will correspond to the sub-stations D-3 for direct current. For heavy traction work on the Chicago, Milwaukee & St. Paul Ry., where it is proposed to handle 1,600 tons on 1% grades, the sub-stations will be located from 18 to 24 miles apart, the feeder being 1,000,000 cm. Considering a direct current section having sub-stations 20 miles apart, the distance between transformer stations for single-phase current will depend on the worst conditions that should be permitted to occur. Thus with the direct current with a voltage drop of 50%, trains could be handled at one-half speed with full tractive power. With single-phase the maximum drop permitting this condition would be from 20 to 30%. The latter figure will be taken as most favorable to single phase, and the distance apart of stations calculated: 1st, when the number of trains on a section is proportional to its length; 2nd, when the same number of trains are concentrated at the centre of a section irrespective of its length. The spacing of the stations can also be calculated when the efficiency is the same for both systems, the number of trains per mile of track being the same. The results are as follows:—

Limiting operating conditions, trains uniformly distributed or number proportioned to length of section.................. 30 miles.
Limiting operating conditions, same number of trains at centre of section.. 45 miles.
Equal efficiency, number of trains proportioned to length of section.. 30 miles.

The limiting operating condition with the number of trains proportioned to the length of the section is evidently most important from a general railroad standpoint, and transformer stations, say $33\frac{1}{3}$ miles apart, would apparently give substantially equal service compared with direct-current sub-stations 20 miles apart. The total capacity of the direct-current sub-station will exceed that required in the conversion station, since each sub-station must be able to carry the load of the trains that may be starting in its vicinity. The total cost of the single-phase stations is, however, increased by that of the transformer stations, which cost one-third as much per kilowatt capacity as the conversion or sub-stations. The two systems are thus equal in cost when the sub-station capacity with direct current is 44% greater than the conversion station for single-phase. In some cases the difference is not sufficient, but lines will not be electrified on which traffic is insufficient to render the load reasonably uniform. As in the case of the transmission line and trolley the single-phase was more expensive; in this case the direct current will be in general slightly higher—the net results being very closely the same.

The remaining items are: A-6 the single-phase locomotives, D-4 the direct-current feeder, and D-6 the direct-current locomotives. The feeder proposed is of 788,000 cm. area, costing at 18 cents per pound, $2,250 per mile or $2,500 per mile erected. The cost of the locomotives will vary according to the type and capacity, but based on direct-current locomotives costing $40,000, those for single-phase current will cost $60,000, so that if one locomotive is used for each eight miles of track, the total cost of the two items is again substantially equal.

The net result is that where power is obtained from three-phase distribution, the cost of electrification by single-phase or direct-current is substantially the same. This is confirmed by several careful independent estimates. With direct current the expenditure on feeder copper and sub-station apparatus is balanced by the slightly increased cost of the trolley and transmission line for single-phase current and the much greater cost of the locomotives.

COST OF OPERATION.

Cost of operation is affected by the efficiency of the system, the cost of operation of the sub-stations and the cost of the maintenance of the locomotives and other apparatus.

The efficiency of the system will determine the cost of the power supplied, and, if the movement of the trains and the power they each consume is known, could be calculated with considerable accuracy. When power is purchased, especially water power, the cost depends on the peak

load during certain hours, and trains will be operated to reduce this as much as possible. It is therefore difficult to forecast the train distribution. There is, however, no general evidence to show that greater efficiency may be obtained with single-phase than with direct-current equipment. Several records of actual service show that with direct-current under similar conditions the results are more economical than single phase. This is especially so when the power per car mile is considered on account of the greater weight of the single-phase equipment. From what we have already learned and figures published, it may be safely assumed that on any section of a railway on which there is sufficient traffic to justify electrification, the power required by direct current will not exceed that required for single phase.

The cost of sub-station maintenance and operation is greater for direct current. On a 100-mile division there would probably be five (5) sub-stations, each containing moving apparatus which requires attention as against one for single-phase system. Each of these sub-stations would cost from $3,000 to $4,000 per year, or say $18,000 per annum, against $4,000 for the single-phase station. It is doubtful whether the wages cost of $2,000 per year per station, or $10,000, is a proper charge against the direct current. On main line work it will be absolutely necessary to arrange to cut out any portion of the road on which accidents may occur, and for this purpose attendance will be required. Trains must be moved away from any section temporarily disabled to prevent congestion, and of the $14,000 additional cost it would appear entirely fair to estimate that about $8,000 is the most that would be entailed by the sub-stations. This is more than equalized by the greater cost of maintenance of the single-phase locomotive. Direct-current locomotives are being maintained for 3¼ cents per mile, of which 2 cents is entirely separate from the electric motor, control, etc. On the single-phase locomotives, the cost has been higher, but it is hoped to reduce it to between 5 and 6 cents. For short distances the direct-current locomotives as used out of New York will handle a train that requires two single-phase, and if this were allowed for, the difference would be very great. The new switching and freight locomotives on the New Haven, it is stated, have been maintained for a comparatively low figure, but they have as yet not been in service sufficiently long to give a final value. The construction of all single-phase locomotives is far less sturdy than that of direct current, on account of the difficulty of keeping the weight down to a reasonable amount, and the construction is far more complicated. It cannot be expected, therefore, that they can be maintained for a lower percentage of their total cost. A fair difference to assume is that cost cannot be taken at less than 2 cents per mile for locomotives of equal power, say 1000-H.P. each. Considering a division with 1,000,000 miles per year, or $20,000 at this figure, so that the cost of operation and maintenance of sub-stations is more than taken care of by the increased cost of maintenance of equipment. The single-phase locomotive is also considerably heavier than the direct-current for equal power, and this is especially true when motor car equipment is considered. This increase in weight means a correspondingly reduced train load, unimportant on level districts, but of appreciable amount on heavy grades. It also entails an additional expense for power which is serious in

light passenger or motor car service. There is, of course, a possibility that 2400-volt direct-current apparatus will cost more to maintain than 600 or 1200-volt, but there does not appear to be any reason to fear its becoming excessive. While there is no doubt that the New Haven have had more electrical trouble than the New York Central and the cost of repairs has been higher, due to the mechanical construction of the locomotives rather than to the electrical equipment. This mechanical construction is, however, necessitated by the use of the single-phase motor. While there is no reason why the same construction should not be employed with the 2400-volt direct current system as with the 600-volt. In general, there is no reason to expect the cost of operation with the single-phase system to be less than that with the direct current.

TELEGRAPH INTERFERENCE.

One of the objections to the use of single-phase current is its effect on telegraph and telephone wires. It is stated that this may be overcome by the use of suitable apparatus or by moving the wires to about 200 feet from the power lines. It is questionable whether either of these modifications will entirely eliminate the difficulty, and it is certainly an objectionable feature. With direct current the corresponding difficulty arises from electrolysis, but this is far less important in railway than in street railway work, in which it has been largely overcome.

POSSIBLE DIFFICULTIES WITH 2400 VOLTS.

The above discussion considers that 2400-volt direct-current will prove equally satisfactory as 600 or 1200-volt installations. In a system that has not been thoroughly demonstrated in practical service, there are some features from which trouble may be experienced, and these are discussed as follows:—

The simple and strong design of the direct-current locomotive is partly due to the use of geared locomotives for freight service and gearless for passenger service. The construction which has been adopted and which is practically necessary for single-phase locomotives of any size, supports the motor entirely independent of the wheels, the latter being driven through springs or connecting rods, thus reducing the dead weight to that of the wheels and axles alone, while retaining the same total weight on each wheel. The centre of gravity of the locomotive is also raised to a point approximating that general for steam locomotives. From experiments conducted on engine and tender trucks and the experience of maintaining track under various types of locomotives, it is safe to assume that the dead weight of 9,000 to 10,000 pounds per axle on gearless locomotives and the slightly greater weight on geared, does not, for the services in which they will be respectively used, appear likely to affect the cost of track maintenance sufficiently to justify the additional expense and complication involved in reducing it. In view of the greater total weight of the single-phase locomotive it is very doubtful whether its effect on the track will not be greater than the direct-

current locomotive, even though the dead weight per axle is higher in the latter. Increasing the height of the centre of gravity reduces the lateral shocks on the rail, but this action is caused by these shocks in steam locomotive design being absorbed by the vertical movement of the springs. It will be unfortunate if electric locomotive design cannot be developed in which these shocks are absorbed by springs, or frictional methods of restraint, so that the simplicity which should accompany the application of motors to drive the wheels of a locomotive may be retained; there is no reason to doubt this being accomplished. Should it prove impossible, the direct-current locomotives would become more complicated and approach the single-phase more closely in cost, the difference being probably 25% in place of 50%.

The question of current collection at 2400 volts at high speed has been experimented with, but not fully demonstrated as yet in service. It has been found practical to collect 200 amperes at 60 miles per hour from one roller trolley without injurious sparking, which at 2400 volts equals 480 Kw. Two trolleys can be located 20 feet apart, thus permitting 960 Kw. on one locomotive. This question is important, but there seems little question of its being solved satisfactorily. The control of 2400 volt current does not appear to present any difficulty. Contractors will be arranged to break the current in series, and from results in operation there seems no reason to anticipate any more trouble with 2400 volts than with 600. Maintenance of motors may be higher with 2400 volts than with 600 volts. The motors will, however, operate under 1200 volts each, and the fields in both motors will practically be at ground potential. Twelve hundred volt motors have operated interurban work for five years without indicating any increased cost on maintenance, and while this has been in a dry climate, the forced ventilation to be employed in railway work will give very closely the same condition. The 2400-volt motor will have the same capacity to stand heavy starting load, the same freedom from commutation trouble, and in general the same ability to stand the severe service imposed upon it by locomotive or traction work that the 600-volt motor has been proved to possess.

The operation of fan and compressor motors on high voltage has to be properly worked out. There are no doubt some difficulties in this respect, but they should certainly be overcome by experience.

COMPARISON OF SYSTEMS.

It has been shown that on the assumption that the 2400 direct-current and the 11,000-volt single-phase current system each operate as satisfactorily as their advocates claim, that there is comparatively little difference in their cost of installation and operation. Each is equally flexible, each will operate and in all probability give a high degree of satisfaction compared to steam locomotives. The principal difference is that, with the direct current a larger portion of the cost of installation is in feeder copper and conversion apparatus, and less in the locomotives, and a larger portion of the cost of operation is in the sub-stations, attendance and maintenance in place of locomotive maintenance. This of itself should prove decidedly

to the advantage of the direct-current system, as the sub-station apparatus is stationary and can be carefully maintained, and the simpler and cheaper the locomotive the less danger there will be of a break down. In addition, the investment in copper is permanent, while that in locomotives may rapidly depreciate with any new developments. There are, in addition, some minor points worth attention which may be referred to.

The regulation of speed on the single-phase system is in many ways preferable to that on the direct current. By drawing current from the transformer at the voltage suitable to the speed and power required, all speeds are equally efficient, and the use of resistance in the circuit is avoided. This is an exceedingly ingenious method, but it is doubtful whether it is of great practical importance. While the direct-current motors have only two full-power efficient speeds, decreased power can be obtained at higher speeds than either of them by field control with very small loss in efficiency. This would apply particularly in passenger service, since in freight service the characteristics of the motor are such that it would not be required. The use of a transformer on the single-phase locomotive permits the operation of the motors at low voltages, and on ungrounded circuits. There seems, however, no reason to fear the use of high voltage on the direct-current motors, or danger, providing it is properly insulated. There has certainly been more trouble on the single phase from grounds than on the direct current, and it appears to be entirely a question of proper insulation. The relation between the speed of the motor and the power it will develop is different for single phase and direct current. Taking two motors which will develop the same power at a given speed, the direct current will develop greater power at lower speeds and less power at higher speeds than the single-phase motor. This is the reason for the success of the direct-current motor in traction service. It can exert a greater pull without injury and is less liable to damage from overheating when starting a heavy load than any other type of motor. It is also this feature which makes the gearless locomotive a possibility for passenger service, as it enables a motor of reasonable size to start a passenger train without the use of gearing to furnish the necessary power. Direct-current motors can certainly be constructed to handle passenger trains at high speed if desired, so that in this respect the advantage is greatly in its favor. The direct-current motor has obtained its reputation for ruggedness from its capacity to withstand heavy loading without injury, and this quality is of the greatest importance in railroad work.

CONCLUSION.

If in place of discussion the relative advantage of single-phase and direct-current traction, the start is made from the direct-current system with its simple and strong electrical apparatus developed after years of experience by simply an increase of voltage, and assuming that this increase does not lead to unforeseen difficulties, the question becomes, What is gained by the use of single-phase current?

It does not save in cost of installation or operation.

Its application is not more flexible.

It introduces a locomotive that is more complicated, in which the motor is necessarily far more expensive and elaborately constructed, and which weighs considerably more than one for direct current.

It reduces cost of sub-station attendance at the expense of locomotive maintenance, and consequent reduction in reliability.

The general advantages to be gained by electrification are too well known to bear repetition, but it might be mentioned from the data now becoming available from those installations now in operation that results obtained confirm estimates very closely. The engineers of the Chicago, Milwaukee & St. Paul Railway, estimate that at least a saving of 25% will be made in operating costs on the 440 mile division now to be electrified in the Western States, and part of this saving is confirmed by the showing already on the Butte, Anaconda & Pacific Railway, where power cost has been found to be but one-third of the previous coal cost. The decision to electrify the suburban lines of the Pennsylvania Railway about Philadelphia, was made to relieve the existing congestion by increasing the capacity of terminal 15 to 20%, or sufficient to relieve the situation for the next five or six years and at less expense than any other method.

DISCUSSION.

The Vice-President: I think we are exceedingly fortunate in having the Chief Electrical Engineer of the largest transportation system in the world to talk to us on this subject. And this is probably the most important class of work in the electrical field, undergoing rapid development at the present time. There is no question but that there will be tremendous strides made in the electrification of steam railways within the next few years. I think that members of this Association should keep pretty closely in touch with what is going on, because some of our members will go into that class of work and those who do not go directly into it will no doubt be called upon to furnish power for operating railways. We will be very glad to hear from any of the members if there is any discussion on this subject.

Mr. S. B. Hood: Mr. Shaw's paper is particularly interesting to me as I have always taken a great interest in the electrification of railways, both steam and tramway systems. I know in Toronto, where I have the task of trying to keep a comparatively small 600 volt system in operation, 600 volts has simply reached the limit. We have to come to something else if we are going to get good results.

Just when I think I have my mind fixed one way, along comes somebody else and fixes it the other way. I happen to know, from close information, the method of maintenance on the New York, New Haven & Hartford in the early days and it is wonderful to me that the locomotives ran at all, whether A.C. or D.C. In a great many cases I think the comparison has been unfair, for we all know that the method of maintenance on the Pennsylvania is excellent.

It has also been interesting to me to note that, in connection with curing some of the troubles, particularly the telegraphing troubles, on the New York, New Haven & Hartford, they have come to the use of auto transformers, doubling their voltage. I would like to hear from Mr. Shaw what his idea is of that system of curing things.

Another point which rather confused me is in the case of the Pennsylvania electrification of their main line. We find the Pennsylvania operating already one of the largest 600 volt D.C. electrifications in the world, if we include their New York terminal work and the West Jersey and Sea Shore divisions, but in spite of that and the supposed good results obtained from it, on their later electrification of the main line they have adopted a single-phase system with overhead catenary.

Mr. Shaw: On the New Haven one of the principal troubles encountered was the increased insulation necessary on trolley, which had to be devised and took some years to work out. The auto transformer equipment has now been in service some months, and from the reports published the decrease in telegraphing interference has been greatly improved; it has not given a complete cure, but it has improved matters 80 to 90 per cent. it is claimed.

The reason of the Pennsylvania Railway in deciding to use single-phase for its suburban electrification, which was decided on to improve the capacity of the Philadelphia Terminal, has not been given in an engineering way yet, to my knowledge.

The Vice-President: Mr. Shaw states that the largest amount of current that has been found practical to collect is 200 amperes at 60 miles an hour. Are there not some larger amounts of power than that used in connection with some work that has been done? What are the conditions on the New York Central?

Mr. Shaw: Yes, there is the third rail. The Butte-Anaconda locomotive is the largest yet used on 2,400 volts, and no difficulty has been experienced, at low speeds, with the collection of current up to 400 amperes. Running at high speed, the limitation seems to be about 200 amperes.

A Delegate: Might I ask Mr. Shaw how the high speed arrangement is obtained on page 5, where you state that if the voltage is dropped 50 per cent., trains could be handled at one-half speed with full tractive power. How do you arrange your motor for this?

Mr. Shaw: Due to their inherent characteristics, the D.C. series motors will run on 50 per cent. of the line voltage at 50 per cent. of normal speed, as motors will decrease in speed almost proportionately with the decrease in voltage.

A Delegate: Will it not take an abnormal amount of current?

Mr. Shaw: It will be increased, but the increase is not very large. In railroad work one has got to keep in mind that the time for which the line voltage will be dropped 50 per cent. is going to be over a very short period, with fluctuations such as do occur in all kinds of railroad electrification work.

A Delegate: We are to understand this is only momentarily.

Mr. Shaw: Yes.

A Delegate: With regard to that 25 per cent. saving in the operating cost, about what is the power cost there?

Mr. Shaw: I understand it is in the neighborhood of half a cent per KW.H. The coal cost has been about $4 per ton. They are to receive their energy from five power plants of the Great Falls Power Company. The conditions are rather favorable there on account of the large load now carried by the Great Falls Power Company. There are very few power companies that can afford to offer a straight meter rate to the railways.

The Vice-President: If no further discussion, we will pass on to the next paper. I will now call on Mr. H. J. Magdsick to present his paper.

RECENT DEVELOPMENTS IN INCANDESCENT LIGHTING UNITS.

By H. J. Magdsick

Since the introduction of incandescent electric lamps in 1879, improvements in both the lamps and accessories have followed with great rapidity. The past year is notable as showing greater progress than any that have preceded. The developments in Mazda lamps have been along two principal lines: Improved methods of disposing the filaments within the bulb and increased efficiency of light production.

The importance of the first-mentioned development has not been realized generally, although new applications of electric lighting have resulted therefrom, and the high-efficiency lamps were to a large extent thereby made practicable. In place of the usual mounting of the drawn tungsten wire in almost straight form, the coiled filament construction was introduced. The wire, wound on a mandrel of very small diameter, forms a helical coil, which allows a given length of filament to be greatly concentrated.

This construction made possible new forms of lamps. Previously it had been impossible in one unit to get a sufficient length of filament in a single line for the usual circuit voltage, but, with the new construction, tubular lamps 1-in. in diameter and 12-in. long with one line of filament were made available for circuits of the 110-volt class. They fill a requirement that has never before been satisfactorily met in the lighting of show-cases. The same lamps are applicable for lighting pictures, bulletin boards, etc., and make possible a very considerable saving in the cost of installing lighting systems for dressers and mirrors. Thus, in the case of a large hotel now under construction, it was possible to provide adequate illumination by placing one of these tubular lamps above the dresser, instead of having an outlet on each side, as was formerly required. In this way one outlet was saved in each of the 2,000 guest rooms.

The coiled filament has also made possible small decorative lamps of the 110-volt class. Lamps with bulbs as small as 1-in. in diameter and with candelabra bases are now available, and are helping to popularize a wider use of electricity.

Lamps with especially concentrated filaments are opening important fields in connection with projecting apparatus. 100, 250, and 500-watt lamps can now be utilized with parabolic reflectors and connected directly to regular lighting circuits. A wide variety of applications for such units suggest themselves. The use of small motion-picture machines for residences, clubs, class rooms, etc., will be given a strong impetus.

But of even greater interest than the new forms of lamp construction are the increases in the efficiency of light production. The extent of the progress made is indicated in the following table and graphically in Fig. 1.

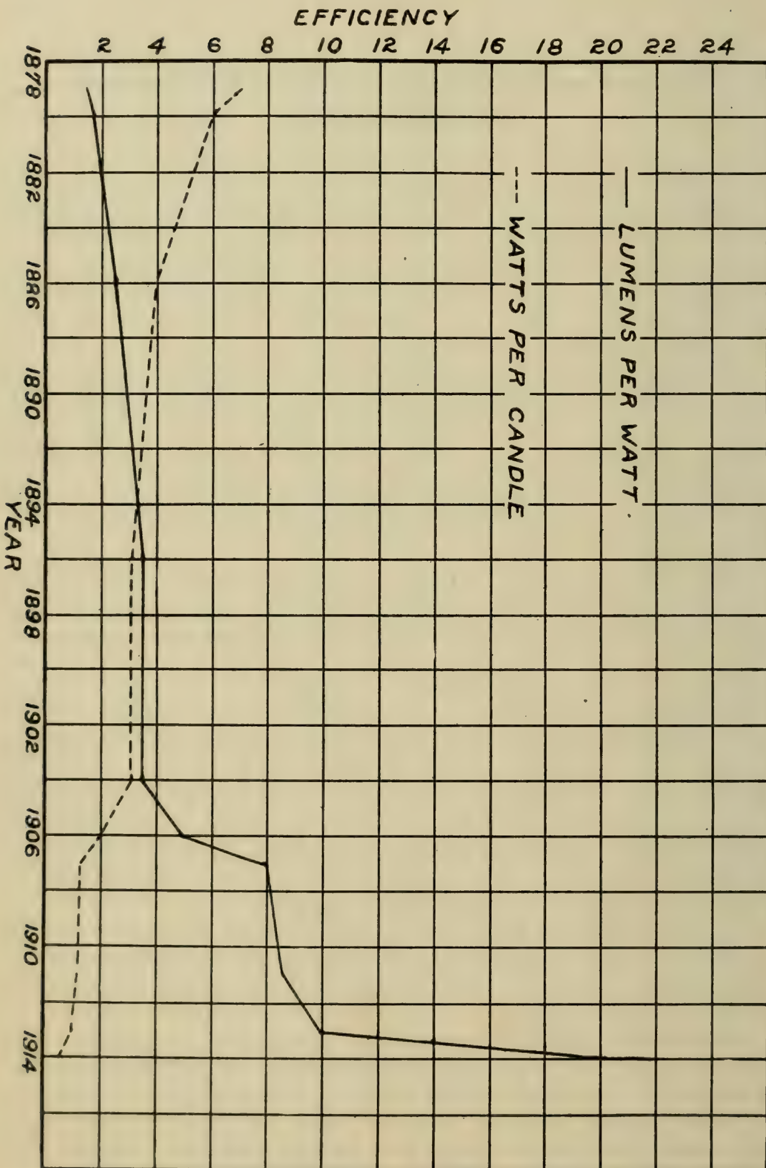

EFFICIENCY
2 4 6 8 10 12 14 16 18 20 22 24
YEAR
1878 1882 1886 1890 1894 1898 1902 1906 1910 1914
--- WATTS PER CANDLE
— LUMENS PER WATT.

Fig. 1.

Progress in Efficiency of Incandescent Lamps.

Year.	Filament Material.	W.P.C.	Lumens per Watt.
1879	Bamboo	7.0	1.42
1880	Untreated Carbon	6.0	1.65
1886	Treated Carbon	4.0	2.59
1896	Treated Carbon	3.1	3.34
1904	Treated Carbon	3.1	3.34
1905	Metallized Carbon (Gem)	2.5	4.14
1906	Tantalum	2.0	4.96
1907	Tungsten (Pressed Filament)	1.25	7.94
1911	Tungsten Drawn Wire	1.15	8.62
1913	Tungsten Drawn Wire	1.00	9.92
1914	Tungsten (Gas-Filled)	0.50	20.85

It will be seen that the increase in the amount of light produced per watt is greater for the past year than for the thirty-five preceding. Some idea of the economic significance of this fact may be gained by considering that almost $400,000,000.00 are expended annually on this continent for electricity used in lighting units. With the lamps of one year ago, for every 100 heat units at the coal pile of a large modern Central Station, only about 0.6 of 1 unit was delivered as light. With the large, high-current lamps of to-day, fully twice this amount or about 1.2 units are obtained as light. It is considered a great achievement if a saving of 2 or 3 per cent. is effected in the losses anywhere between the coal pile and the lamp socket, yet for illumination with large units this development is as significant as would be the doubling of the efficiency of the prime movers.

The efficiency of light generation in an incandescent lamp is dependent upon the temperature at which the filament operates. The theoretical limit of efficiency is the melting point of the filament material. The practical limitation, however, is the temperature at which a filament may be operated without evaporating at a rate which will cause rapid blackening of the lamp bulb. Since the introduction of the tungsten-filament lamp an effort has been made to lessen the blackening of the bulb in a number of ways. Previous to the present year, various chemicals or "vacuum getters" were introduced to neutralize in part the effect of filament evaporation. This method resulted in substantial gains. The far greater increases in efficiency of the past year, however, were accomplished by the introduction of an inert gas in the bulb to increase the possible operating temperature for a given amount of evaporation. A filament in a vacuum evaporates at a lower temperature than when under pressure, just as water will boil at the freezing point in a vacuum, but at a very much higher temperature in the atmosphere. It was found that nitrogen gas at a pressure of somewhat less than one atmosphere when cold gave satisfactory results, and this method has been used in all gas-filled lamps so far placed on the market.

Although the use of the gas permits the operation of the filament at higher temperature, it introduces an element of inefficiency as well. In

a vacuum lamp part of the heat is conducted away by the leading-in wires and stem while the rest is radiated. When a gas is introduced into the bulb a further method of heat dissipation is added in the form of convection currents set up in the gas, which carry the heat directly from the filament to the bulb of the lamp. This loss depends largely upon the area of filament surface exposed, so that a filament of greater diameter and heavier current-carrying capacity loses relatively less heat in this manner than does one of small diameter, since, in the latter case, the surface exposed is far greater per watt of energy consumed. If two lamps of identical filament construction, with an evacuated bulb in one case and a gas-filled in the other, are connected in series so that the same current passes through each of the lamps, the filament in the vacuum lamp will glow much more brightly than the other, since the heat is not dissipated so rapidly. If the filaments are of small diameter, the current may be increased beyond a practical operating condition, but the gas-filled lamp will still be less efficient than the vacuum. If, however, the filament is of sufficiently great diameter, it may be operated at the higher current value, which will cause the filament of the vacuum lamp to evaporate rapidly, but will not so affect the filament under gas pressure, and a condition of operation is finally reached where a higher efficiency is secured in spite of the cooling effect of the gas.

As was stated above, the use of coiled filaments has in a great measure made the present high efficiencies possible, for, when the wire is coiled, it takes on to some extent the heat-dissipating properties of a thicker filament. The reason why, up to the present time, gas-filled lamps have been made successfully only in sizes taking about four amperes or more, and have been most efficient in the higher current sizes, is thus apparent. Units so far available are those of 400, 500, 750 and 1,000-watts for multiple operation on circuits of 110-volt class, and series-burning lamps of candle-powers ranging from 60 to 600 on 5.5, 6.0 and 7.5 amperes as well as 15 and 20-ampere units in the higher candle-powers—400, 600 and 1,000. The efficiency of the series lamps varies from 0.5 W.P.C. for the 20-ampere units to 0.79 W.P.C. for the 60-candle-power 5.5-ampere. 1,000-watt multiple lamps operate at 0.55 W.P.C., while the 400-watt with filaments of smaller diameter require 0.75 W.P.C. The efficiencies, as compared with those of the vacuum lamp, are even greater than the ratings indicate, since the mean spherical candle-power is a greater percentage of the horizontal candle-power in the case of the gas-filled. For further increases in efficiency and for gas-filled lamps of lower wattages it is probably necessary to look to other methods of disposing the filaments or to the use of other gases.

The effect of these latest lighting units on illumination practice is already apparent. On every hand are seen installations for display purposes in front of theatres, stores, garages, etc. They will doubtless soon supplant the gas arcs formerly used in this field of lighting, and, because of the greater attractiveness of the installations, greatly extend the use of electric light for display purposes.

The lamps find important application in the illumination of large stores, particularly where the ceilings are sufficiently high to make the use of high candle-power units desirable. Not only do the new lamps permit a higher standard of lighting for a given expenditure, but the quality of the light is far superior to that received from the vacuum Mazda lamps. The difference in whiteness of the light from the present gas-filled lamps and the vacuum type is fully as great as that between the vacuum Mazda and the carbon incandescent. For most departments of a store they offer a distinct advantage from this standpoint. The greater efficiency of the units will stimulate the installation of more decorative systems of lighting, as well as the use of partially and totally indirect systems. In many of the large department stores we find but one unit for a bay whose dimensions are from 20 to 25 feet. With older systems of lighting, the resulting illumination has usually been insufficient and lacking in uniformity. Since the filament in the new lamps is concentrated into a relatively small space, the light can be controlled more readily with properly designed reflectors. A prismatic reflector has recently been developed which, when placed inside of a semi-indirect bowl, spreads the light out over a large ceiling area, with a resulting better appearance of the ceiling and a far more uniform distribution of light on the goods.

With the new lamps it also becomes practicable to supply light corrected to the value of sunlight or daylight for departments where this is required. Enclosing glassware is now available with which the desired correction is accomplished. Such units are also applicable in the lighting of art galleries.

In industrial lighting there are certain processes in which the whiter light of the gas-filled lamps is of value in making color distinctions. In all high-bay areas in steel mills, foundries, shops, etc., the full advantage of the high efficiency of the new units may be realized.

The lighting of building exteriors with projector units employing the concentrated-filament lamps offers great possibilities. The system is particularly applicable to public buildings and other monumental structures and wherever a dignified advertising medium is sought.

The light from the new Mazdas contains a considerably larger proportion of chemically active rays than that from the vacuum type. This increase in actinicity, together with the increase in efficiency, permits three times the speed of exposure with a given wattage. Two 1,000-watt units give ample intensity for short exposures in portrait work. The light is of such a character that the various colors are given their true value in the photograph. The units have an advantage in ease of control equalled by no other illuminant and at the same time require a far lower investment. Photographers have long been looking for an inexpensive artificial lighting system which would make it possible for them to continue their work independently of the time of day, and relieve them from the necessity of changing their methods and time of exposure with the varying conditions of daylight encountered. It is probable that the photographic studio with a skylight will be a rarity within a few years. The advantage of a portable

lighting equipment which enables the photographer to go to the homes of his clients is obvious.

Nowhere can the saving resulting from the more efficient lamps be realized so rapidly as in the street lighting field. Here, again, the progress in accessories has kept pace with improvements in lamps. Because of the concentrated form of the filament, it has been possible to develop a prismatic refractor unit which gives more than double the horizontal candle-power of the bare lamp at the angles most useful for street illumination, as is shown by the distribution curves of Fig. 2. This refractor con-

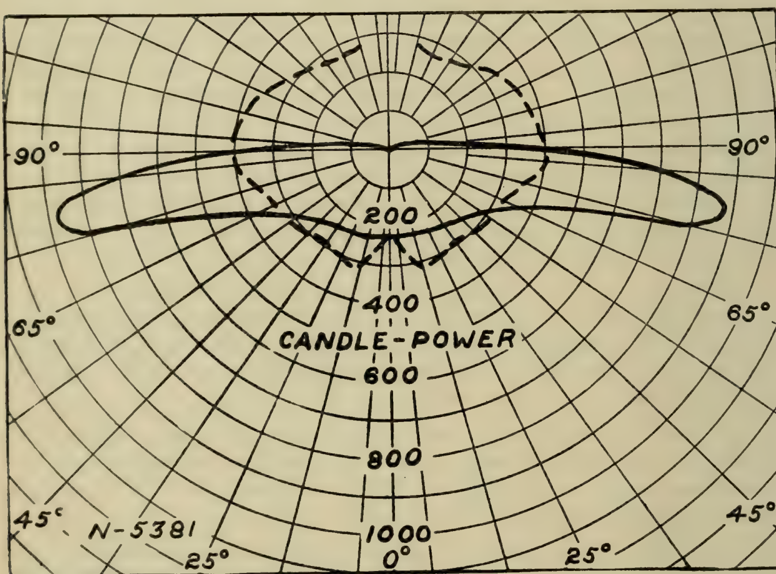


Fig. 2.

sists of two bowl-shaped parts, fitted one over the other, and closely joined so as to make a weather-proof unit. The outside bowl contains on its inner surface a series of vertical diffusing prisms. The inner is girded on its outer surface with horizontal prisms, which redirect the light at the angles desired. When the unit is assembled, therefore, the prismatic surfaces of the two bowls are facing each other and enclosed in a weather-proof chamber, so that dust cannot collect on the prisms. The outer surfaces are smooth, and therefore the unit is easily kept clean. Highly efficient in the control of light, rugged in construction and low in maintenance cost, the Holophane prismatic refractor is, without a doubt, the most effective accessory yet developed for the illumination of streets.

It is interesting to note what results can be secured to-day compared with a year ago. At that time a 60-candle-power series lamp required 65 watts. The most efficient accessory available was the radial wave reflector, which increased the candle-power at 10 deg. below the horizontal

by 25 per cent. or to 75 candle-power. The new series lamp using 65 watts emits 100 candle-power bare, and, when equipped with a radial-wave reflector, this is increased by 40 per cent. The concentrated filament of the new lamps allows the reflecting surface to be brought closer to the centre of light, which adds to the effectiveness of the equipment. Equipped with the prismatic refractor, however, an intensity of 200 candle-power is secured at 10-deg. below the horizontal from the 100-candle-power lamp. At present, then, because of the increased efficiency of the lamp and the concentration of the light source, for 65 watts there is delivered, at the useful angle, 200 candle-power instead of only 75 candle-power.

In addition, to-day we have larger sizes of incandescent units giving 250, 400, 600 and 1,000 candle-power, so that there is no field of street lighting in which incandescent lamps, with their steadiness of light and ease of maintenance, cannot now be employed at a low operating cost.

From the Central Station standpoint, the gas-filled lamps have a very decided advantage over the carbon arc lamps, of which there are many still in service. For example, 6.6-ampere alternating current carbon arcs take 425 watts and emit an average of 265 candle-power at 10 deg. below the horizontal. A 400-candle-power 6.6-ampere Mazda lamp takes only 244 watts and emits 875 candle-power at this angle, or more than three times the intensity of the arc. Furthermore, the power factor of the arc lamp system is of the order of 65 to 75 per cent., while that of the Mazda, with a constant-current regulator, is about 85 to 90 per cent. The capacity of the generating and transforming machinery and other apparatus is, of course, limited by the kilovolt-amperes rather than the power taken. It will be seen, therefore, that the incandescent system requires less than one-half the station capacity needed for the arc-lamp system. Where alternating-current regulators are already installed for arc lamps, the replacement for Mazda units requires only the expense of the fixtures for the incandescent units themselves. The regulators can be used with two of the old circuits connected to each. The municipality, therefore, obtains greatly increased illumination on the streets at a considerably reduced cost to the Central Station.

As has been previously stated, the loss due to the cooling of the filament by the nitrogen gas is less in the higher current than lower current lamps, and, therefore, lamps built for 20 amperes operate at a considerably higher efficiency than those designed for use directly on 6.6-ampere circuit. This gain in efficiency averages between 20 and 25 per cent., and has led to the introduction of small series current transformers or compensator to step up the current at each lamp from 6.6 to 15 or 20 amperes. Whether the compensator unit or the straight series type is, in any given case, the more economical to operate, depends upon the cost of power and the fixed charges on the compensator equipment. In most cases it will be found that in units of less than 400 or 600 C.P. the saving in energy is not sufficient to offset the extra investment required for the compensator and its housing. Furthermore, straight series lamps cannot be operated satisfactorily on the same circuit with the type of compensator generally used to-day, unless the regulation is unusually good. Compensators are to be recommended,

therefore, in cases where circuits of high candle-power lamps only are required, and especially in cases where the cost of energy is lower.

DISCUSSION.

The Vice-President: This is certainly an intensely interesting subject to every Central Station man, and particularly with regard to the question of street lighting. However, as far as some classes of business are concerned, the Central Station man looks upon it with somewhat mixed feelings, as he sells KW. hours and does not sell light. I am sure there will be a lot of questions to be asked.

There are one or two questions I would like to ask myself. One is in regard to the life of lamps, and another as to whether Mr. Magdsick can say anything as to the approximate selling price of the lamps.

Mr. S. B. Hood: There are just two points on which I would like to ask you a question. First, as to the nitrogen lamp—has it been investigated as it should be with regard to the explosion of the lamp? Of course, we do not know at what pressure the gas is put in, and, naturally, when heated the pressure must increase. I understand there have been several cases where the lamps have exploded. Of course, with vacuum lamps, and breakage of the bulb, the fragments simply go in and fall down like a kind of shower. If the nitrogen lamp explodes in an enclosed room, such as a public room or restaurant, it flies all over the room and might be very serious.

The second point is in connection with small street lighting units. We are operating quite a large suburban light system, using 60-watt multiple tungstens. It occurred to me, if we could get a nitrogen lamp which could be operated in multiple, or some class of multiple series, that we could very well afford to change those units for nitrogen units of equivalent consumption and thereby give the municipality practically double the light, and, at the same time, not increase our cost.

A Delegate: In regard to using the larger size nitrogen lamps in interiors, I would like to ask if there are any special means brought out of dissipating the heat where you use the lamp inside a glass bulb?

Mr. H. H. Magdsick (closing the discussion): The Chairman has expressed the fear of some Central Stations that the lighting load will be reduced by the new high efficiency lamps. The reply to this is obvious—the greater efficiency creates a demand for better lighting. Our experience in the past has been that the Central Station business is reduced in very rare instances by increases in lamp efficiency. Increases in the intensity of street lighting, display lighting and store interiors will raise the standard of illumination in smaller stores and residences. The rapidity with which this influence acts has been surprising.

The life of the new and the old type lamps is practically the same. The regular multiple lamps are rated at 1,000 hours' and the street series at 1,350 hours' life.

The danger from explosion of the lamp is no greater than that from the old vacuum lamps. As before stated, the gas is introduced into the bulb at considerably less than atmospheric pressure, so that, when the lamp

is burning and the gas becomes heated, the pressure will be just slightly lower than that of the atmosphere. There is, therefore, no great explosion should the bulb be broken.

The heat dissipated from a lamp of a given wattage is, of course, the same for the vacuum and the gas-filled types. The impression that the gas-filled types give off more heat is due to the fact that much of the heat is carried to the bulb by convection in the gas-filled lamp, while in the vacuum type a larger part of the heat is radiated. Furthermore, the gas-filled lamps with which people are most familiar are much larger than any of the vacuum type, and the dissipation of 1 kilowatt of energy in a very small space necessarily entails a certain rise in temperature. Multiple units of 400 watts and above should be ventilated, and the same is true of series units of 400 candle-power and over.

THE VICE-PRESIDENT: I think we owe a very hearty vote of thanks to Mr. Magdsick for coming and giving us this talk. Certainly it was very well worth while listening to.

We have to hear from Mr. Magalhaes as to the Meter Committee.

AN INFORMAL REPORT OF THE WORK DONE BY THE METER COMMITTEE OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION, DURING THE WINTER OF 1913 AND 1914.

By G. W. Magalhaes

The three principal subjects taken up by the Meter Committee for the past year have been:—(1) Maximum Demand Indicators; (2) Standardization of Instrument Shunts; (3) Legislation Affecting Meters.

Maximum Demand.

The increasing popularity of demand rates has necessitated the development and production of demand indicators to give the maximum demand on the customer's installation. The committee endeavored to standardize these indicators. Their first step was to obtain from the member company their wants and requirements along these lines. This was obtained by sending out circular letters containing a certain number of questions on the problem of demands. These questions elicited a great variety of answers, indicating more than anything else the chaotic condition of the maximum demand question at the present. There were time intervals all the way from one minute to sixty minutes. There were advocates for and against every one of the existing instruments. While these replies were coming in, a general meeting had been arranged between the Meter Committees of the National Electric Light Association and the Edison Illuminating Association, together with representatives of the various meter manufacturers. The discussion at this meeting brought out the fact that at least two or three grades of instruments were required to take care of the various classes of service. For instance, a large power contract, which had "off peak" clauses in it, required a more complicated instrument than a contract for residence installations, where simply the highest demand for the month was required, irrespective of the time during the month at which that demand occurred. At this meeting the manufacturers emphasized the point that they could not economically manufacture any instrument until the needs of the Central Station had been more standardized. As it was, a manufacturer could not make any layout for the cheap production of an instrument and then find that the instrument did not meet the requirements of the Central Station business. The manufacturers were more than pleased to have had the opportunity to meet with the representatives of the Association and to discuss, face to face, both sides of the question. The tangible result of this meeting was the appointment of a committee to investigate the present instruments on the market, thoroughly testing them and to report in detail. The Meter Committees felt that they would then be in better shape to take up the standardization of demand indicators. Up to the time of the Convention the joint committee had not completed its test. These tests are being carried on by various of the member companies and by the testing laboratories.

Standardization of Instrument Shunts.

This question was taken up with the Committee on Electrical Apparatus. These two committees sent out to the manufacturers a letter asking for their specifications in connection with instrument shunts, and also inviting them to meet with the two committees at an open meeting, at which the question of standardization of the "drop" and of the terminal construction of shunts was to be discussed. Thanks to the co-operation of the manufacturers, the joint committees were able to make recommendations for two standard millivolt "drops" on the shunts for three general classifications. It appeared to be too drastic a move to make one standard at the present time. The two standards represent co-operation and a willingness on the part of the manufacturers to work in with the Association.

Public Utility Regulation.

This embraces all legislation and regulation affecting meters. During the past year there have come to the notice of the committee five (5) new commissions, eleven (11) commissions adopting new rules, and one (1) case of state laws and municipal ordinances. In some of these cases, where the Meter Committee has been notified, it has placed itself at the service of the member company affected by the proposed legislation or ruling, and, together with the executive of the N.E.L.A., has taken up with the various commissions the question of the proposed legislation and have been instrumental in moulding these new rules. It has met in all cases with a cordial reception on the part of the commission, who have welcomed the expert knowledge that could thus be brought to bear on the formation of new ruling. A case in point was the co-operation between the Wisconsin Railroad Commission, who were establishing new rules and regulations covering electrical service, and the Meter Committee. Their rule No. 28 covered the question of demand instruments, and at first required impracticable limits of accuracy. This was brought to their attention by the Meter Committee, and they laid that rule on the table, stating that this rule had been suspended for one year or until an investigation and report by the various utilities committees had been made, it being the opinion of the commission engineers that the matter could be adjusted within the year, or, if not, further suspension of the rule could be requested.

Other matters were taken up by the committee, but the three above questions were the most important ones dealt with during the year.

The main points to be noted are the individual efforts of the various member companies, committees and members of committees. Also the hearty co-operation which was met whenever any question was taken up with others interested in the question in point. The individual members of the committees worked hard and gave a great deal of their own personal time; the member companies give a great deal of their men's time in connection with work that is carried on by the committees; the manufacturers also spend a great deal of time and effort in experimenting, and are only too glad to supply any instruments or meters to companies for testing purposes. All of this effort results in the valuable information which the various committees are able to give to the member companies.

I want to take this occasion to speak of the unique exhibit which is at the entrance of this hall. That is down on the programme as having been arranged by myself, but I want to place the responsibility—I won't say responsibility, but the praise of that where it belongs. Mr. Davies, of the Montreal Light, Heat & Power Company, has done all the work. I did a little correspondence with the manufacturers, getting the meters sent up here, but Mr. Davies has had full charge, and I want him to get full credit for it.

Mr. Higman: Might I be permitted to correct a misunderstanding which seems to prevail in regard to the question of accuracy of measurement of meters in Canada. While there are, as is correctly stated, five or six Provincial utility commissions, they have nothing whatever to do with meters and their accuracy. The question of weights and measures pertains absolutely to the Federal Government in Canada, and there is a provision in our laws which requires all manufacturers to send to the Department at Ottawa a sample meter, with full drawings and specifications, for approval of the meter before it can be put on the market. The law also states what variations may be allowed in the accuracy of the meter, and also with respect to voltage and frequency.

I may say that Dr. Stratton, of the Bureau of Standards, asked me, I think as long ago as 1905, to go down to Washington and discuss with the authorities there the Canadian system, with the view of applying some general scheme of inspection throughout the United States; it was found, however, that the different States had supreme control of the commercial application of the system of weights and measures, hence the impossibility of applying the Canadian system in that country.

DISCUSSION.

The President: If there are any questions in connection with this report of Mr. Magalhaes, we will be glad to hear it now, so that we can get on with the programme.

There may possibly be some discussion in connection with the paper of Mr. Davies yesterday.

Mr. D. H. McDougall: I think this very useful and well written paper should not be allowed to pass without a very animated discussion on the points involved, together with the paper read by Mr. Wills on a somewhat similar topic—in connection more generally with mixed business of light and power—Mr. Davies' paper being more restricted to power demand.

In the first place, when the company approaches an intending consumer —possibly a man about to establish an industry of some kind, or having already an existing steam plant—it seems to me that it is necessary, first of all, to show the man that he is able to effect an economy by taking a Central Station service. This we are able to do without very much trouble. But, should we give the man more than a sufficient inducement to make him see the necessity of changing his electric supply service? If he establishes a steam plant, he has to provide not only for his maximum demand, but practically for his connected load; that is, in case of growth of his business,

extraordinary conditions and abnormal prosperity, it is necessary for him to increase his installation from time to time at a greatly added capital expense. He economizes on space occupied by his plant, and various other things which are well-known to us all, by taking Central Station power. Therefore, I think the companies might almost defend the position of assessing, as on a primary charge basis or as a charge represented by the investment the companies have to make for that service, the connected load or arbitrary proportion of the connected load, rather than a demand. That would give us, naturally, a very much larger return than we are able to obtain on demand basis. Having that in mind, and having decided possibly that the demand basis is all that really affects our service, should we agree with the statement that a demand should be a monthly demand rather than a progressive demand? Our summer load is our problem, in order to work up to yearly load factor record, and if a man establishes a peak in December, surely the Central Station is entitled to consider that the investment made for that plant's service is liable to be called upon on the following December, and, consequently, the man should make some payment for the standby.

The question of duration of demand has been spoken of, and it has been suggested by the writers of the papers that two demands of five minutes might be accepted as an equitable basis. I, personally, think that it would be preferable and fairer if the companies should decide on accepting a basis of the highest average 20 minutes of the month. That is, taking the highest peaks on the curves for a period of 20 minutes in consecutive time and averaging the peaks of that period. I do not know mathematically how that would work out in comparison with two five-minute peaks, but it seems to me if you had four or five peaks, ignoring the question of the duration of those peaks, in period of 20 minutes and averaged those, you would probably get a better result from the Central Station standpoint, and, at the same time, a fair result to the consumer.

I regret that I did not hear fully the first paper, and I have had no time whatever to go into Mr. Davies' paper, other than having heard it read, but it is certainly a contribution which the Association should fully consider, in view of the fact of the rapid advancement in demand meters and the fact that in Ontario the Hydro-Commission are talking low rates and endeavoring to fix a one-minute demand, or not more than five-minute demand, with the idea of using that basis as talking points to delude the customer.

Mr. G. Ratcliffe Hulme: Mr. Davies invites us to help him in determining the basis upon which the maximum demand should be measured. I, for one, would like to decline the invitation. I do not think that it is altogether wise for us to fix any definite standard. It seems to me to be akin to the hatter keeping one size and one type of hat to suit all his customers. Imagine the result, Sir, if I had perforce to wear a hat two or three sizes too small or too large for me. Well, to my mind, the fixing of a standard for the supply of power is akin to that of fixing a definite size of hat for everybody. As a result of my experience, I have found that probably the most satisfactory way—satisfactory alike from the Central Station point of view and from the consumer's point of view, is to take careful

tests of the consumer's installation before settling the basis of the charge for power. Those tests preferably should be made in the morning, at the time of the power peak of the Central Station and also in the evening at the time of the lighting peak of the consumer's normal loads, care being taken to see that the tests are fairly representative. Having ascertained those, you will see what percentage of that particular power load will overlap your lighting load, and you will, I think, then be able to form an idea as to the profitable character of that particular installation and how to derive the greatest benefit from it.

We are public utility companies with duties to the public, and we are bound to treat all comers fairly and squarely. We cannot follow what is, I believe, the practice of some railroads in charging as much as the traffic will stand. Now, I am a believer in a low rate of charge for power, but when the power load comes on top of the lighting load, then I think we lose a great deal of the benefits which would otherwise accrue to us, and, consequently, it behooves us to be very careful indeed in quoting very low rates for power.

There are a number of points connected with the ascertaining of the demand, which would take more time than you could spare for me to mention, but generally, Sir, I think you will find—at any rate, we have found on the other side of the water—that if we do fix an unalterable standard, we lay up for ourselves a heap of trouble. And I, for one, would not like to see the electrical industry of Canada saddled with a millstone of this character around its neck. I would therefore suggest to you, Sir, the advisability of very carefully considering whether it is desirable to set up a standard; because, the moment you start to apply a standard you are faced with the questions which we heard of yesterday and to-day also, such as the duration of the peak, and you are unable to treat each particular case on its merits and so gain the consumers' good-will and a profit to yourselves.

Mr. Davies: Mr. Hulme believes that it is unwise to fix a demand time and method of determination. He states that his belief is based on English experience; possibly owing to this fact he is not aware of the enormous growth of power load attached to the Central Stations on this side of the water. The power business is becoming a greater revenue producer than lighting business. In the City of Montreal we have about 50,000 lighting customers and approximately 2,500 power customers. The power revenue is at least equal to the lighting revenue, and it becomes of increasing importance, therefore, to see that the power consumers are standing their share of the cost.

The habit of mind in the past has been to regard power load as being something in addition to lighting load, something that is added on to help out the system generally from a financial point of view; but, in view of the increasing use of power, it seems that in a short time power load will be the important load and the lighting load will be the smaller load that will have to be considered as to its effect upon the power load, rather than the effect of the power load upon the lighting load.

From 5,000 to 10,000 tests per annum have been regularly taken on individual customers in Montreal, in order to determine consumer's demand and billing basis, and from a study of these there is no doubt whatever that this type of test leaves an open road to discrimination in favor of either the consumer or the company.

It is extremely difficult to take a test on a customer's factory or his workshop requirements and determine a good average condition. The human equation has to be depended upon. The owner or superintendent in charge of the factory or workshop may be quite a straight man and may, in all sincerity, state that the load he is going to put on is about his average load, but it is very liable to be the case that he will estimate this condition having regard to his own affairs more particularly than having regard to the supply company's interests. On the other hand, the inspector or tester will naturally endeavor to obtain the biggest load he can. Between the two, depending on whether the man whose load is to be tested has the stronger character or whether the man who is making the test has the stronger character, there is a great possibility for variation, which in itself is discrimination. Added to this you have the fried-fish dealer mentioned by Mr. Hulme—in Canada translated very often into dollars. Although the very best men are employed and are, no doubt, generally worthy of trust, there is always a half chance that such a consideration may influence the result of the test. On the other hand, the conditions of load when recorded on a meter are known accurately. The standardizing of this load—having found it—would, in my opinion, be an excellent thing. There are so many different methods of determining the demand, that it would be a great thing to have a method standardized once and for all. Different industries may need different methods, but it is not necessary to standardize one method of determining demand for every class of business. Certain classes of load can have the method of determination standardized, and other classes of load which cannot stand such a rigid determination of demand can be considered and given methods with fairly elastic limits.

Mr. McDougall spoke of connected load as being one method of determination for the customer's fixed charge; whereas this is a method of apparently overcoming the evil of discrimination, it is in itself open to the discrimination offered by the fact that the choice of motors is often carried out in a careless manner.

It is quite possible that, if the rating of 70 per cent. of connected load be taken as the basis for the fixed charge, that in the case of such uses as pumping, fans, etc., the load on the motor may be 100 per cent. of the rated capacity, whereas in the case of cranes, foundries, etc., the maximum demand may be as low as 25 per cent. of the installed capacity; and furthermore, as probably Ontario engineers are aware, there is always present the possibility of the rating of motor being incorrectly stated and a motor of, say, 100 H.P. having a name-plate affixed stating that same is a 50 H.P. motor.

The desire of operating companies is to obtain a just factor, and while there is no desire to squeeze the last ounce out of the customer, neverthe-

less it is very desirous that the company's interests are properly protected.

Mr. G. R. Hulme: Might I interpose a moment to make my remarks quite clear? I have been in this country for nearly four years and have studied the power situation closely. I happen to be a director of a hydro-electric company which has a gross annual revenue of nearly a million dollars, of which 90 per cent. is derived from power. It follows, then, that I am a firm believer in the value of a power load. My remarks were intended to primarily refer to the cases of the small power stations, particularly those operated by steam, where the coincidence of the power and lighting loads is a most important factor in determining the earning power of the plant installed. It is from the standpoint of those stations that I think it is unwise to fix a standard method of determining the maximum demand.

Mr. P. T. Davies: There is one little remark I would like to make regarding method of test for loads. I would say that I have found, in making over 200 tests by graphic meters, that it showed that the company would receive 10 per cent. more by taking graphic charts than by taking an outside load.

The President: As the time is getting on, Gentlemen, and I know you are all ready for lunch, I feel however that we cannot close without thanking Mr. Davies for his excellent paper of yesterday, and express the regret of those present at our not being able to continue with the discussion when so many were present who were much interested in what he had read.

I wish to thank Mr. Magalhaes for his report on the Meter Committee of the N.E.L.A. It is following up a new departure this year in having representatives of our Association on the different committees of the N.E.L.A., and we feel next year we should have from each such committee representative a report, giving his own conclusions and his experiences in connection with the working of the respective committees.

Before closing this Convention, I must refer to the splendid spirit shown and the large attendance at this meeting in Montreal. It is beyond question a record meeting, and the perfection of all arrangements is certainly most commendable. It shows what business heads like those connected with the electrical interests of Montreal can do when they get together, and how well a Convention can be run electrically. It is most gratifying to all of us to feel that, in this Metropolitan city, this Convention has been the largest on record. I hope that we will continue to climb and that next year's Convention, wherever it may be held, will be still larger. We must all realise that a new spirit has been induced into this Association.

We particularly appreciate the presence of so many guests this year, not only of gentlemen friends and those who are indirectly connected with the electrical interests, but of the many ladies who have come to encourage us and to participate in the splendid programme offered by the Montreal committees.

Our object is to serve the public and to serve it well and faithfully and with the best ability we can obtain, and it is an encouragement to feel that

those outside of our ranks appreciate our efforts. It certainly is gratifying to have the attendance that we have had here in Montreal.

If there is no further business before this Convention, I feel that we should not, and cannot, close without extending a hearty vote of thanks to the Standing Committees of the Association for last year. In view of the fact that they were appointed at practically the eleventh hour, the work they have done is most notable.

A resolution has been moved by Mr. Hulme, seconded by Mr. Bird:

That this Convention expresses its indebtedness to the Standing Committees of last year for their admirable and efficient services. (Carried unanimously.)

The President: All of us here must feel a deep debt of gratitude to the members of the Montreal committees. (Applause.)

Mr. T. S. Young: The resolution which I desire to present is:—

That this Convention offers its most hearty thanks and the expression of its keen appreciation to the Chairman and members of the Montreal committees for the splendid arrangements made for the 24th, 25th and 26th of June, during the 24th Annual Convention of the Canadian Electrical Association.

It has been my privilege, with many other members of the Association, to have attended Conventions for ten years or more, and on no occasion have we been more royally entertained than we have on this occasion. Too much credit cannot be given to the members of the Entertainment Committee, and, while we cannot hope to have a Convention in Montreal every year, we shall look forward to the time when we shall return here for another Convention. After this resolution has been seconded, if it is your pleasure, Mr. Chairman, I would like to see it endorsed, not in the usual conventional manner, but by a standing vote of the out-of-city members and three cheers and a tiger.

Mr. Higman: I have been asked to second this motion, which I do with very great pleasure. I shall not detain you with many words, because it seems to me, under the circumstances, words would be superfluous. We have heard something more or less about standards during the course of these meetings, and I am bound to say that our Montreal friends have set a standard that will keep other places in Canada hustling to live up to. I have great pleasure in seconding the motion.

The motion was carried enthusiastically by standing vote and three cheers and a tiger.

The President: According to our Constitution, we should at this meeting decide upon the place for the next Convention. I think Mr. Dodridge has a resolution.

Mr. Dodridge: I have pleasure in moving the following resolution, seconded by Mr. Dion:—

That a selection of a place for the 25th Annual Convention has been delegated to the incoming Executive Committee. (Carried.)

The President: As this is the close of the business, I cannot wind up, Gentlemen, without thanking you for the honor you conferred upon me last year in electing me to the high office of President.

I can only ask that the members of the committees appointed for the incoming year may give their President the same hearty co-operation that I have received this year, and I wish to thank these gentlemen very sincerely for the able assistance that I have received from one and all, and, had it not been for their hard work, I am quite sure that the work of the Association this year would have fallen very flat.

Mr. G. W. Magalhaes: Mr. President, you have overlooked one thing which you would naturally omit. I wish to move a vote of thanks to our President for the efficient manner in which he has conducted the Convention which was arranged for us by our Montreal friends.

A Delegate: I am sure we are all deeply indebted to Col. Street for the able manner in which this Convention and the meetings have been conducted. I have great pleasure in seconding the resolution.

Mr. A. A. Dion: If you allow me, Mr. President, I will take the Chair. Gentlemen, you have heard this motion. What is your pleasure regarding it?

The motion was carried with a hearty clapping of hands.

Mr. A. A. Dion: It gives me a very great deal of pleasure to tender to you the thanks of this Convention for the able manner in which you have filled the Presidential Chair.

The President: I thank you most heartily for this resolution. I assure you that I cannot really quite understand why you elected me last year, when many men were more able than I; many men who were technically, at any rate, very much better fitted for the high office. However, I have endeavored, with the able assistance of the Executive and the Chairmen of the committees, to carry on the work of the Association, and sincerely trust that our work for the past year not showing failure, may possibly have sent us forward. It is possible that the seed we have sown this year will reap fruit in years to come.

Mr. A. A. Dion: I would like to ask the forgiveness of the members for my taking the liberty of jumping into the Chair without being invited. It was to save time.

I wish to say to any representatives of operating companies who may be here, that they must, on no account, fail to attend the meeting this afternoon. It is one of very great importance to operating companies, and it would be a misfortune if any of the Class A members should fail to attend.

The President: I declare the Convention adjourned to 1915.

Canadian Electrical Association

Proceedings of Executive Meeting held at close of Twenty-Fourth Annual Convention, Montreal, June 26th, 1914.

For private circulation among Class A members of the Association.

Canadian Electrical Association Executive Meeting
Friday, June 26th, 1914

The President: I now call the meeting to order and the first business on the programme will be the Report of the Nominating Committee. Mr. Dion is Chairman of the Nominating Committee, and I now ask him to kindly read his report.

Mr. A. A. Dion: Mr. Chairman, the Nominating Committee has considered very carefully the question of elections for this year, with special care of the fact that special work has been started in the way of reorganizing the Association, if you shall so call it, because the Association at the beginning of this year found itself in a condition that was far from desirable. The plans that have been laid down for reorganization are not complete, and the opinion has been expressed by many of the members that it would be inadvisable to "swap horses while we are crossing the stream," and that for this reason we should suggest, possibly, re-electing the principal officers of the Association.

The Committee recommend as follows: It must be borne in mind, however, that it is a mere recommendation and that any member here has the privilege of making other nominations.

President, D. R. Street, Ottawa.
1st Vice-President, D. H. McDougall, Toronto.
2nd Vice-President, R. M. Wilson, Montreal.
3rd Vice-President, Wills Maclachlan, Toronto.
Hon. Secretary, T. S. Young, Toronto.
Sec.-Treasurer, Alan Sullivan, Toronto.

For Managing Committee:

J. S. Gould, Smith Falls.
G. W. Magalhaes, Toronto.
P. T. Davies, Montreal.
H. G. Matthews, Quebec.
A. E. Dunlop, Pembroke.
J. S. Norris, Montreal.
George Kidd, Vancouver, B.C.
Robin Boyle, Niagara Falls.
W. G. Angus, Hamilton.
W. S. Robertson, Toronto.
E. L. Milliken, Sydney, N.S.
L. W. Pratt, Hamilton.
H. R. Mallison, Montreal.
G. Ratcliffe Hulme, Montreal.

The President: Will you put that in the form of a motion?

Mr. A. A. Dion: If there are no other nominations I would move that the Secretary cast a ballot for that ticket.

Mr. Julian Smith: I second that. Carried.

The Secretary: Mr. Chairman and gentlemen, we sent out a number of letters asking various gentlemen interested in our work to be present. I have a telegram from Mr. H. B. Scott, new President of the N. E. L. A. (reads).

Also have a letter from Mr. Burdett, who is counsel for the N. E. L. A. He has been quite ill and not in working form, but he has taken the trouble to write a personal letter, as follows: (reads).

I have also a letter from the Cape Breton Electric Company, per Mr. Milliken: (reads).

Also a letter from the Franco-Canadian Collieries: (reads).

A letter from the North Shore Power Company. I am unable to say from memory whether the North Shore Power Company is represented here or not: (reads).

A letter from Mr. Harkom, of the Richmond County Electric Company: (reads).

The President: We desire at this meeting to make a new departure, by the election of the President of the National Electric Light Association of the United States as a member of the Executive of the Canadian Electrical Association. This is a decidedly new departure and is done to make more clear the fact that the Canadian Electrical Association, while working in harmony with the N. E. L. A., is but a sister society; this we desire to demonstrate to those who might on imperialistic or sentimental grounds think that we ought to be a purely Canadian society; we are such, but are proud to work hand in hand with our sister society the N. E. L. A.

Canada is today emerging from the caterpillar stage to that of butterfly existence, and we feel that we have very much to gain and nothing to lose by co-operation. The N. E. L. A. has done tremendous work in the United States, it has an enormous membership, as the convention in Philadelphia illustrated, a registration of over 4,000, and the immense field that the Association covers makes us feel that we have everything to gain and certainly nothing to lose and very little to give, and that this affiliation is very much for our own direct benefit.

For that reason I would be very glad to have a motion to that effect made, that the President of the N. E. L. A. be appointed a member of our Executive.

Mr. Smith: Mr. President, it gives me great pleasure to make that motion.

Moved by Mr. Julian C. Smith, seconded by Mr. Hayward:

"That whereas the Canadian Electrical Association is a sister society of the National Electric Light Association, and the President of the Canadian Electrical Association is ex-officio a member of the Executive Committee of the National Electric Light Association, and the bonds between the two societies are closely drawn, and whereas there exists between the two societies a free exchange of information, it is resolved that the President of the National Electric Light Association be, and hereby is, appointed ex-officio a member of the Managing Committee of the Canadian Electrical Association, in addition to the 14 elective members, as provided in the Constitution of this Association."

Carried unanimously.

The President: It would be quite in order in this meeting of Class A members to endorse what was done at the last session of our Convention, and that is, pass a resolution expressing our very high appreciation of the work done by the Montreal gentlemen who have made this convention such a success, have made it indeed a convention far ahead of anything we have had yet, in point of attendance, good work, and in enjoyment for the lady guests who have accompanied us.

Mr. D. H. McDougall: I have much pleasure in moving:

"That the officers and Managing Committee and members of the C. E. A. desire to express their great appreciation of the signal services rendered the Association by the Montreal Convention Committees, and congratulate them on the success of their efforts both in finance and organization, and offer to the Ladies' Committee their sincere thanks for the perfection of its arrangements."

Mr. Wills Maclachlan: I have much pleasure in seconding.

The President: It has been suggested by various gentlemen for many years connected with the Canadian Electrical Association that we should not allow our past presidents to slip away from us, but that we should take advantage of their experience, which experience we need and need badly. It has therefore been suggested that an Advisory Committee be appointed consisting of the past or ex-presidents of the Association. A motion to that effect is in order now.

Moved by Mr. J. S. Gould:

Seconded by Mr. Wills Maclachlan:

"That whereas the Canadian Electrical Association is greatly indebted to its past presidents for long and faithful service, and whereas the Association is unwilling to lose the honor and help of their participation in directing the affairs of the Association, I move that those past presidents who are at liberty to still co-operate with us be asked to form an Advisory Public Policy Committee to act with the Standing Committee of Public Policy, and that in token of the regard held for them by the Association they be also asked to accept gold badges, with a draft of this resolution."

Mr. A. A. Dion: Before this is put to a vote I would like to say

something which may sound as a discordant note in this harmonious meeting. I am one of the past presidents; I have been on the Executive for nearly twenty years without any interruption. Now, if this means that this Advisory Committee is to be a live, real Advisory Committee called upon to do active work, I am in sympathy with the motion. If it means that we are to be put as ornaments on a shelf to be admired but never to be called upon to do any work, I object to the motion. Mr. Bird is one of the past presidents who is now on the Executive Committee. I think it would be too bad to lose the active support of men who have filled the presidential chair. We have had men who have been presidents and we have put them into the Executive Committee as simple members of that Committee afterwards and they have done good work. This motion, if carried, would probably put an end to this practice. When a man has been elected to the office of president, and his term of office is ended, he will not be eligible for the Managing Committee, but he will be put on this Senate of the Association, which, perhaps, will never be called upon to do anything or have any voice in the affairs of the Association. If it is understood that this is to be a live committee and that these men who have gone through a training school and are most able to help the Association, are to be allowed to help them, then I am in full accord with the motion.

The President: I might say that in making this new committee that the intention is not only to have one or two of the past presidents in active work, but to have the co-operation of all, if at all possible. The idea is that the members of this Advisory Committee shall receive notices of all meetings of the Executive just as any member of the Executive shall receive them and so attend these meetings if at all possible. Instead of putting them on the shelf, as you say the possibility may be, it is the very opposite. The idea is to bring them into active, hard work. We feel that those who in the past have served so long and faithfully upon the Executive Committee have proved that we cannot do without their advice and experience. It is for that very purpose that such change is now proposed.

Before adopting this motion, I wish to ask the past presidents to accept a gold badge—something a little above the ordinary—from the Association. It can be worn as a mark of distinction. Therefore, after the adoption of this Resolution, I will present these badges.

Mr. J. S. Gould: I would like to say as mover of the Resolution that I do not think the motion intends to debar past presidents from election to the Advisory Board. That was apparently the inference to be drawn from the remarks of Mr. Dion. I do not think that is the intention.

The President: Not at all. But this year, I understand, at least I would infer from the personnel of the Executive as named by Mr. Dion, of the Nominating Committee, that the past presidents have been left off the Executive, but it is to be understood that they as

members of that Advisory Board are practically members of the Executive.

This is the Resolution as submitted by Mr. Gould, seconded by Mr. Maclachlan; is it your pleasure that it should be carried?

The President then presented the gold badges.

Mr. D. H. McDougall: Is the President going to get his?

He got it.

The President: I can assure you I appreciate the honor very much indeed. It is, I believe, almost an unprecedented honor in the history of our Association to be selected as your President for a second term and I can only say that I will do the very best in my humble way to further the interests of the Association, counting, as in the past year, upon the able assistance given me by the members of the Executive, which will be supplemented this year by the work of the ex-presidents and, furthermore, I will have the able assistance of the members of the various committees, which committees, I understand, the past Executive have requested shall be continued for the coming year. I can assure you, gentlemen, that it will be my earnest endeavor to continue the good work of the Association, which, I believe, has taken a new lease of life, and by this time next year we may have in our Association every one of the 334 privately owned companies in Canada. (Applause).

There are questions of great importance to bring up before the Class A members at this meeting. The members of your Executive, realizing that a crucial point had been arrived at in the life of our Association, felt also that something almost heroic had to be done to obtain a new lease of life, and to make ourselves useful, to pound into both the federal and provincial governments the knowledge that the electrical interests in Canada should be and would be a recognized factor; that they can not be overlooked; and that there is both capital and vote behind their influence.

The Secretary will read in a concrete form a programme of what is intended this year, and after you have heard it I will be glad to have expressions of opinion from the gentlemen present.

We have with us here today Mr. Martin, the Secretary of the N. E. L. A., who can tell us what that Association has been doing for Central Station companies. We have also Mr. Henderschott, representing Mr. Arthur Williams, Chairman of the Public Policy Committee of the N. E. L. A. We have Mr. Kerr, who represents the Public Service Economics Branch of the N. E. L. A., and Mr. Blood, who has done very efficient work superintending the insurance or rather directing the insurance of the member companies of the N. E. L. A. In addition I am glad to see present many representatives from our own Class A membership, prominent gentlemen, Empire builders in Canada, who are doing everything possible to advance the work of electricity.

This programme of work will cover the question of memorializ-

ing the federal and provincial governments, particularly the provincial governments, towards the establishing of commissions in the provinces, thereby creating a legalized monopoly of the electric light business under government control. This is found to work very satisfactorily in the United States.

If you will allow me, I will quote from Mr. McCall, late President of the N. E. L. A., in his address at Philadelphia:

"The principle of governmental regulation through the medium of state commissions has been generally adopted throughout the country, most of the states in the Union now having commission boards, and controlling thereby the operation of all the public-service companies. In the main, the activities of these commissions have led to a better understanding of the relations between the public and the utility company."

We know, particularly in Ontario, what the duplicating of plants and the encroaching of municipal organizations means. This is bound to spread. I will now ask the Secretary to read the programme submitted by the Executive of your Association.

The Secretary reads report as follows:

Report of Managing Committee

Dear Sirs,—At a meeting of the Managing Committee held in Toronto on April 15th, serious consideration was given to the proposal that a special campaign should be inaugurated. It was further decided that this campaign should be in the exclusive interests of the privately-owned companies having membership in the C. E. A. I, therefore, beg to submit the following, to which the Managing Committee asks that you give your serious attention.

The best way in which to point out the magnitude of the interests involved in privately owned companies in Canada is, perhaps, to state that in 464 municipalities there are 336 privately owned plants and 174 municipal undertakings. Out of this number of 336 privately owned plants 58 are members of the C. E. A. Most of the large companies are included in this membership, but it can be seen what a wide influence will be exerted should those not now in our ranks be induced to join us. Our Class "A" companies represent an investment of $110,000,000, made by more than 3,200 individuals as shareholders and owners. On these companies over 3,100 employees are dependent and received in wages, during last year, over $2,000,000. It is thus apparent that any movement resulting in whatever benefit to interests of this magnitude is a most desirable and important thing.

The Executive of your Association has already, during the present year, rendered signal service to its Class "A" members in securing a reduction of 50 per cent in the annual tax on net earnings of privately owned companies in the Province of Ontario, which tax, as set forth in the original draft of the Corporation Tax Act, was 1 per cent. At the meeting above referred to, the representatives of four Class "A" members estimated that an annual saving of $10,000 has

been effected to the four companies there represented, and every other privately owned company in Ontario has benefitted in proportion. In addition to this, your Association, by its representatives, secured for the operating companies a very considerable benefit in the Meter Inspection Act. Inspection fees were cut down and inspection on premises was secured. Further benefit was attained in the Electric Inspection Act by securing the co-operation of the principal Government Inspector in charge of this work.

Your Committee feels that it is now imperative that some united move be made to improve the present standing of privately owned companies, who are in the anomalous position of being subject to the jurisdiction of an organization with which they are in active competition—that is, the Hydro-electric Power Commission. This demands serious and immediate attention. The effect of the operations of the Commission upon citizens at large has, so far, been psychological. The man on the street is inclined to think that power with current supplied by the Government, at what the Government calls "cost," is more interesting to him than current supplied at rock bottom rates by a privately owned company, which has to pay taxes, dividends on its stock, etc. So far no move has been made by privately owned companies in Canada to combat this, except the efforts of individual organizations made in protest against a condition of affairs which indirectly amounts to confiscation of their business.

Your Committee feels that prompt action ought to be taken to remedy this state of affairs, and, furthermore, since such action could not, by reason of its very nature, be a matter for public discussion, it should be the subject of concerted and private effort on the part of privately owned companies.

This is the object of our meeting to-day.

It has been stated that the opinion of the man on the street was the best asset of any company. Your Committee is strongly of this belief, and yet, while the Hydro-electric movement is acquiring more and more impetus, the privately owned companies have as yet done nothing conjointly to obviate what must be the inevitable end, if it proceeds much further unopposed

It will not be assumed that the educational and defensive campaign of your Committee is in favor of first rushing into the papers and denouncing the Hydro-electric. It is rather to act in combination and attempt to bring about by such a campaign a result which no individual company, however powerful, could produce.

This movement will of necessity take several forms, some of which may be suggested as follows:—

1. It will mean the insertion in the press of well written and non-partisan articles, which will have as their basis the idea of fair play to every citizen, whether he takes current from a privately owned or municipal undertaking.

2. A very important phase is the acquisition of statistics for

private and confidential exchange between Class "A" members. It is quite understandable that there is much information which a privately owned company would be justified in withholding unless it was absolutely sure of the use to which it was to be put. By the proposed arrangement all such information would be used solely and exclusively for the mutual benefit of Class "A" members.

3. The watching of legislation is also vital.

It can hardly be expected that an electrical jobber, even though he be a member of the C. E. A., would cheerfully agree to his fees being used for retaining counsel to act in the interest of privately owned companies from whom, perhaps, he gets no business. The campaign proposed will, therefore, put your representative in a position to act at once to get advance information on proposed legislation and to draw individual companies together to act in unison in defence of their rights.

4. Another point which should be taken care of is the effect that must have been produced in the mind of the foreign investor, who has put, or is contemplating putting money into privately owned electrical undertakings in Ontario. It appears to your Committee that, if done in the proper way, expressions regarding the suicidal policy of the Ontario Government, and perhaps, later on, all other Provincial Governments, could be secured in the columns of influential English papers. Canada being essentially a borrowing community, the various Provincial Governments of Canada often pay to a foreign expression of opinion a deference they withhold from statements appearing in the local press. Your Committee feels this is an important matter, which, if properly and judiciously taken care of, cannot fail to have a beneficial effect.

5. The exerting of all possible influence toward the appointment in each Province of a Public Service Commission which shall regulate the financing, operating, and rates of every public service organization in the Dominion. It is felt that this could be so urged, and precedents so quoted, that the Governments would consider it seriously. If this was secured it would remove us from the jurisdiction of our competitors.

6. Under our proposed arrangements any member company may, upon request, have the co-operation of our Secretary for special work for local publicity purposes, the advice of the solicitor of the Association and the benefit of all assistance of other member companies. We are further assured that the N. E L. A. will be glad to render whatever service it can.

The Hydro-electric movement has, so far, only been operated in Ontario. There are, however, signs that it will be inaugurated in the Province of Quebec, and without doubt the other provinces will in time follow, unless privately owned undertakings entrench themselves so firmly in the confidence of the public that it would not be considered good policy by the Government to interfere with existing

conditions. It will be seen, therefore, that the proposed campaign is important to every privately owned company in Canada. We can, if united, exert a tremendous influence.

As before stated, this will occupy the time of a more than usually capable man, and your Committee estimates that a fund of from $8,000 to $10,000 per year should be secured for a period of not less than three years to commence with. The effect of such a campaign is cumulative. One year's efforts would of necessity be of little avail. The annual cost is negligible compared to the tremendous investment it is designed to benefit. Any surplus from one year's operations will be invested to form the nucleus of a protective fund. Your Committee suggests that this fund be raised in the following manner:

Class "A" members in places of less than 5,000 population, proposed voluntary subscription $40.00 per annum.

Between 5,000 and 10,000 population, proposed $60.00 per annum.

Between 10,000 and 25,000 population, proposed $80.00 per annum.

Between 25,000 and 50,000 population, proposed $100 per annum.

Over 50,000, less than 100,000 population, proposed $200 per an.

Over 100,000 population, proposed $500 per annum.

We are satisfied that we must move and move at once, or else be prepared to accept whatever further injustice may be handed out by vote-seeking politicians. A subscription form has been prepared, and already several companies have signified their readiness to act.

Gentlemen—are you with us?

The President: Before submitting the Resolution in connection with the suggestion of your Executive I would ask Mr. Henderschott to make a few remarks on the psychology of the situation in Canada. Mr. Henderschott, as I said before, is representing Mr. Arthur Williams, Chairman of the Public Policy Committee of the N. E. L. A.

Mr. Henderschott: I will not speak very long. Mr. Williams, whom I know you would all have been very glad to have with you this afternoon, is paying the penalty that every successful man pays of being overloaded with work; by reason of that fact, which is becoming more and more apparent to him, he has permitted me to become an understudy. He is doing most of the home work and I am doing most of the foreign missionary work.

The situation which confronts you, gentlemen of our sister commonwealth, is in no respect different from the situation which confronts us in the United States. As you all know, you are operating your business within the law; you have no sense of feeling that you are criminals, and yet there is a tide, I may almost say, a rising tide of public sentiment which is flowing against you. Perhaps the extent of this sentiment was well illustrated in the opposition which arose to the appointment of one of President Wilson's selections for our new Banking Commission—a gentleman whom it was discovered held one share of stock in the International Harvester Company. And this was considered by many very able men as a sufficient

reason for the rejection of his nomination and is still being seriously considered in Washington. Now, as to the causes for this rising tide of sentiment in favor of public ownership and operation there are many. I am not familiar with the situation in Canada, not nearly as familiar as every other man in the room, but there are in the United States one or two reasons that can be cited; one of which, I think, is the successful completion of the Panama Canal. It was only logical naturally, it was only an exemplification of human nature that the railroads should have attempted to protect the interests which they represented. On the other hand, supposing the securities of the railroads of United States—supposing the railroads to be under government ownership and securities widely held as they would be, there is serious doubt if the Panama Canal would have been dug at all because of the fear on the part of the public that their securities would be jeopardized. There is another factor that I think has contributed considerably to the rising tide of public opinion, which is the Parcel Post; forgetting, of course, that at least a part of the work in carrying out our postal system is performed by privately owned railroads—one of the most important. The postal system at best merely gathers together the mail at one end and distributes it at the other. The transportation must be accomplished by the railroads. Now, if the postal system is efficient then the railroads rightfully should share in that efficiency and should be credited with it. We have, however, a statement of Postmaster General Burlison which appeared in the New York World of last Monday that the postal system is not efficient. I have given a copy of that interview to your Secretary, in which Mr. Burlison states there is a waste of twenty million dollars a year, at least, in the postal system by reason of political influence which brings into the operation of the Post Office Department people who are not only not needed but who actually hinder in the operation of the work. We have another illustration in France, where the postal employees by reason of disappointment in legislation which would have increased their salaries rebelled and tied up the system absolutely. That happened this week. We have just one other instance of what we may expect to happen if the movement progresses sufficiently far that any great centralization of business takes place under government operation, and that is the condition which existed in New York State when Mayor Mitchell attempted to pass or have passed his Police bills which would have brought to New York City Colonel Goethals as Police Commissioner. He found lined up against the Bill between 50,000 and 60,000 civil service employees for the reason that if the Bill were enacted into law it would have removed the right of the courts to pass upon the discharge of an employee of the municipality who was under civil service, and most of them are. There was a condition that never was anticipated.

As a matter of fact it is my judgment that there are two principal reasons for favorable sentiment to government ownership and

control. First, the public has looked upon this new system as entirely favorable. In my opinion that condition will continue to exist until the system has been sufficiently tried out to bring out the unfavorable features of it. We all know it and I believe we all feel that at heart the public is fair. At the same time the public is ignorant in many instances and misinformed in most instances. They have simply gotten the idea that government ownership and control is going to do away with present worries and bring in no new ones. The second reason, as I view it, is poor service.

I conducted a rather superficial investigation as to the causes which led to agitation for municipal ownership. It was not in any sense a complete investigation. Still it was conducted sufficiently far to indicate that agitation for municipal ownership of public utilities in 80 per cent. of the cases was caused primarily by poor service rather than high rates, although rates, of course, came into the question after it had become a public issue. I believe thoroughly that private ownership and private operation is more efficient, more desirable than any public ownership or operation is or ever can be. The reason for that belief is very apparent. There never yet has been as efficient service under public operation as has been attained under private operation. That statement cannot be challenged. In New York City there are 20,000 school teachers and during the past ten years not a single teacher has been discharged for inefficiency. You will find that your problem under government ownership will be a problem of inefficiency on the part of the employee in exercising his functions as an employee, for he will be very efficient in getting the position. Once he gets it it is practically secure, because the civil service will be extended to take them in, and then there will be the Court of Review in case of discharge and the Courts, nine times out of ten, will reinstate the employee. Now, under that condition it requires no argument that you cannot have efficiency.

In testifying before the Committee on the District of Columbia, to whom was referred the Crosser Bill, which has for its object the government purchase of the street railways in the District of Columbia and operation of same—not exactly the government operating them, because the government disclaims all financial responsibility after the purchase has been made, but in testifying before that Commission General Harries, whom you are all familiar with, and who for some time was at the head of the Washington Companies and operated them, made a proposition to that Committee that he would organize a private company to take over all the labor of the government of the United States—that does not include all officials but all of the labor performed by the government, give a bond in any sum which the government would require which would be satisfactory to the government, and contract to perform the labor for fifty per cent. of what it is now costing. And one of the members of the Committee nudged him and said, "You rascal, you would be a millionaire

in a month." Now, it does not require argument that public ownership and public operation can not be as efficient as private ownership and operation. Then what is the basis? The basis is the belief that the corporations have taken advantage by putting out watered stock, that they are not rendering good service, and of course all of us will accept much poorer service from our governments than we will from corporations, and because the public is misinformed or not informed at all.

Now, the remedy, as I see it—and I am not here to suggest anything to you gentlemen in any superior sense; I am simply here to talk this proposition over with you, which is your proposition and which is our proposition, but we have progressed sufficiently far in some instances to know that public good-will can be earned and held And the method by which you can earn and hold public goodwill is simply to take your case straight to the public through an educational campaign. The public, after all, is fundamentally honest and fair. So long as they are not being hit they are not particularly worried or excited over this proposition, not so much worried as we are. But very recently there has been an agitation for municipal bakeries, for municipal newspapers. One was started and ran for about six months out in Los Angeles. To be sure it is not running now, it was too expensive to have carried on municipally. But the idea has sprung up in almost every line of industry. Now, I believe all the public is wanting, all the public is asking or will ask is to have demonstrated to them that you are not earning a greater return upon the actual money invested than you are entitled to, and that you deliver a standard of service that is of the highest character.

To carry out those two ideas you must have a campaign of education. Just how that campaign should be inaugurated, just how it should be carried out, is a matter, of course, for careful investigation and for some committee to handle. We have two such committees. We have a committee under Mr. Gilchrist of Chicago, under the N. E. L. A., and a Committee on Education of Salesmen, of which I have the honor to be Chairman. For instance, in The New York Edison Company, almost by accident, we discovered that we have an average of 20,000 telephone calls per day from the public. There are 20,000 opportunities every day to make friends or the reverse for our company. We are training our telephone operators. Just the tone of voice, just whether the person who calls up gets the person wanted or not—and mind you when a customer or prospective customer takes down the telephone book, looks up The New York Edison Company and calls in, it is not the office boy who answers but it is The New York Edison Company, and whether he passes the person around to three or four other persons before they finally get the information they want, whether he answers intelligently and courteously, and sees they are relieved of all further trouble or bother, determines whether or not you have made him a friend or the reverse.

There is no denying the fact that the privately owned companies must render a better grade of service than a publicly owned service company can or will render. When you have solved that question of courtesy—and I place courtesy ahead of any other thing, just as I place goodwill on the part of the public ahead of any other asset that we can possess—when you solve the question of courtesy, when every one of your people who go out to meet the public are trained to represent you creditably, trained to control their temper, trained to make friends every day they are representing you, you will find public sentiment swinging your way just as we find it in New York City. I believe Mr. Martin will sustain my statements that public sentiment in New York City is and has been for some little time gradually turning in our favor. We conduct three schools. Out of 6,000 men employed in our company we had 1,000 in school the year before last and over 1,000 in school last year. In the Contract and Inspection Department, which is our sales division, and which is composed of those who deal directly with the public, 57.7 per cent. now hold certificates of graduating from our two-year Commercial school course. In 1913 we had just about double the number of customers' meters out that we had in 1907 and less than half the complaints. That is the way we judge results. That is all possible—and I may say if Brother Sullivan will turn around so that you cannot see him blush for a moment, as I happen to know him for quite some time, that you are very fortunate indeed in having Mr. Sullivan to guide this work. A very able man, an able writer, equally careful executive; there is no doubt but under his direct supervision and under the advice and counsel and co-operation which he will receive from all of you, and under what co-operation it is possible for the N.E.L.A. to give you, you can work out a system by which you can render a higher grade of service—perfectly satisfactory service. The problem of rates is before you. You gentlemen understand it better than I do and I shall not touch upon it.

I believe that this is the psychological moment to inaugurate such a campaign just as we have done in the United States, because politicians are beginning seriously to question whether or not after all they have gotten hold of a proposition that is going to solve all troubles, and the public is beginning to question. You cannot destroy this great electrical industry without injuring the public. No argument is necessary to prove that statement, that is what it means if you set up governmental competition that is unfair—and governmental competition is unfair because it does not take into account charges that a private institution must take into account. Their rates are universally too low. They are unable to make good on their promises, assuming that those promises were conscientiously made. They have no such trained skilled forces as the privately owned companies have to work with. It is a political proposition and political propositions always move with popular sentiment without regard to facts. If you

can start in now and perfect a carefully organized conservative campaign of education, there is no doubt in my mind but what you will see adverse sentiment gradually come to a stop and begin flowing in your direction. It is perfectly possible, but I do not believe that you can get that result unless you reorganize, work as a unit and carry the issues squarely to the people. Put it right up to them. Meet every proposition they put out with facts and figures, and when the public becomes convinced that private ownership is preferable, that you are not trying to take from them more than a fair return upon your investment, I believe your fight is won, and from that point on it will simply be a question of developing your business along natural, original lines. (Applause).

The President: We will be very glad indeed if Mr. Martin would favor us with his views as Secretary of the N. E. L. A.

Address of Mr. T. C. Martin

Mr. Martin: Permit me, sir, on behalf of the N. E. L. A. to congratulate you on your re-election and to know that we shall have the pleasure of enjoying your assistance and advice in our National Councils in America.

I am very glad indeed to have the opportunity of stating that we have to-day in the N. E. L. A. our third Canadian President. (Applause). Mr. Scott was born at Orillia—I have not the faintest idea where it is but I know it is somewhere in Canada. Mr. Freeman was born at Exeter and Mr. Frederic Nicholls was born, like myself, on the other side of the Atlantic, but I take him to be a pretty good Canadian from what I know of him. We are very glad indeed to work as closely as we do with our Canadian friends because, to put it even selfishly, it strengthens our hands in the United States, as Mr. Henderschott has pointed out so very eloquently.

I shall limit myself distinctly and briefly to our N. E. L. A. work, which I thought would be of special interest to the Class A members of the Canadian Association.

I wish to say one or two things with regard to our literature which is now absorbing a great deal of our time and attention, probably more than we should give to it, and also tying up a good deal of our spare funds, so that at the present moment the N. E. L. A. has between $15,000 and $20,000 invested in its literature. Two years ago, at Seattle, we brought out our Electrical Meterman's Hand Book, copy of which I have here through the courtesy of Mr. Maclachlan. Of that we printed an edition of 5,000 copies and have already sold nearly 4,200. We tied up in that some $10,000. During the present year we have taken another plunge into the publishing field, whether judiciously or not I don't know, except that we are doing work that no private publisher had undertaken; that that work was necessary and that we found that our Association was really the only channel through which a great deal of information could be obtained. We

therefore have issued an Overhead Line Construction Hand Book this year of some 900 pages, which is a positive mine of information on the entire subject of overhead lines. I might mention it, to give an idea as to what is done on our side by some of the private companies, that the Chairman of that Committee, Mr. Sproule, Electrical Engineer of the Philadelphia Electric Company, had placed at his disposal by the company for a period of some six months an expert engineer to take the data which was furnished to the Committee and assist him in putting it into book form. The contribution of the company, as you can see, was probably in that item alone not less than two or three thousand dollars, which was a generous contribution to the welfare of the central station art. We have printed three thousand copies of that book. We are issuing it at $3 to members and $4 to non-members and in the actual book publication expense, not including overhead expense, have already expended $6,500, and not including the item of 400 or 500 cuts which have gone into it.

We have further, in our Commercial Section, done another splendid piece of work in the publication of this Salesman's Hand Book, which is a compilation of data on practically every item of application of apparatus with regard to which a salesman in meeting his "prospect" is likely to have questions put to him and in regard to which he must be ready with an adequate and competent answer. We have appropriated for this already $2,000, which does not begin to cover the expense of preparation and publication.

Up to the present time we have had in the N. E. L. A. what we call two national sections: one Commercial, the other Hydro-electric and Transmission. At the Philadelphia meeting, at which your President and several of your own members were present, and most welcome as ever, the Hydro-electric section was abolished by vote of itself, and the work will hereafter be carried on by a very large and influential Committee. The Commercial Section, however, as evidenced by such a publication as this Handbook, shows an abounding vitality and vigor and with a special membership of 1,500 has already put itself very definitely on the map. What we did, however, in view of the abandoning of the Hydro-electric Section, was to remove the extra fee of $2.50 per year charged to members of the Commercial Section, so that to-day any member of the Association can become a member of the Commercial Section without extra charge of any kind and on the approval of the Executive Committee will be in a position to receive such literature as this, to the extent of our ability to supply it without any extra charge at all. It would seem as though the natural outcome of such a policy would lead to the differentiation of the membership into various natural groups, so that we undoubtedly will have an accounting section, Steps have already been taken for its formation. We will have, I think, a Technical Section and of course the Commercial Section will

no doubt go on with larger and growing membership. There is, of course, a point of limitation that always confronts such an association as ours and as yours, as we work in together, as to how far we can go in the supplying of literature and of service gratuitously.

When I had the honor of being elected Secretary of the N. E. L. A. in 1909 we had a membership on the underside of 3,000 and the income was around approximately $30,000. I have the great pleasure of being able to state that to-day, very largely through the efforts of our new President, Mr. Scott, Chairman of the Membership Committee, that on the Organization of the Industry our membership has reached very nearly 14,000, making it undoubtedly the largest order of the kind in the world and that our income has run up to nearly $125,000. And although—and you must take it from me—we try to run the affairs of the Association as economically and circumspectly as we can, we spent last year in the work that we did all but $4,000 to the good, which is a very narrow margin for a society to work upon, and does not allow us to accumulate any reserve and also does not and did not allow us to undertake any of the various important features of new work which confront us and which must be attended to in the near future. Hence we made a small revision of the dues, taxing the larger companies a little more, while on the other hand, as I have already stated, wiping out a large percentage of the dues in the sections. For example, one of the N. E. L. A. departments which must be developed in the very near future is the statistical. We get an amazing amount of enquiries in regard to the statistics of the industry. We have already the only fairly complete collection of Central Station rates in the world. We have the records on file in our office of something like 800 to 1,000 companies, consulted not only by our own membership but also I may say from time to time by the public service commissions, with whom we are very glad indeed to work. Now, the creation of such a department necessarily means the development of the Rate Research Committee work and its bulletin and various other features that I need hardly deal with now.

Another department which we have recently taken up and which you have very wisely included in your own programme this week, is that of "Safety First,"—accident prevention. To give you an idea of how much is involved in that, I would say that our own expense for that committee alone in the merest kind of incidentals and useful work is $150 a month. All these things have to be taken care of, and if the N. E. L. A. or C. E. A. are going to live up to their responsibilities they have got to have the necessary resources put into their hands. I wish to say here, as my friend Mr. Henderschott said too, that I am very glad to see that the good work done by our friend Mr. Young, that the foundation he laid is being built up, and I think you will find a handsome and splendid superstructure at the

hands of Mr. Sullivan. But he must have support and must have finances with which to do the work.

In connection, for example, with the proposed Statistical Bureau I happened to take up the subject with one of our member companies along certain lines of development and investigation, and I found that the company was spending $50,000 a year in getting certain information and data and statistics together. I said to him: "If only ten or twelve of the companies would furnish me with $50,000 I could do that work for every one of them within that amount and the industry would certainly be $250,000 to the good." I think it is an absolutely true and irrefutable statement.

There is another very interesting development which I find takes a great deal of time and a great deal of money. During the last two years, acting on the suggestion which came to me from our fertile friend Mr. Henry L. Doherty, I developed a lecture bureau. We have 50 company sections in the United States and Canada. I organized a series of lectures, getting leading men in the industry to contribute, like Mr. Edison on the storage battery and Prof. Elihu Thomson on wireless transmission, and I have developed a lecture system so that I can feed into the hopper of every one of those company sections a course of instructive lectures which will run pretty well throughout the season. The result was during this past year 81 of these lectures were delivered to something like 20,000 employees. We have also organized a service of about 1,000 lantern slides, and have already three moving picture films, and since I have been here I have laid pipe for one or two more.

Now, you can see that that all involves a lot of work. It keeps two people busy all through the winter season and means a lot of correspondence and arranging. It is like having a chautauqua lyceum bureau or a theatrical company with one night stands. In sending those lectures and slides across into Canada I found we get into an awful lot of trouble and mix up particularly with the Custom House, and somehow the slides get hung up at border points and it breaks up the arrangements and the circulation of the lectures and thus the scheme cannot be carried through as successfully as I would like. That is one of the problems that is worrying me, and if any of you gentlemen can offer me a suggestion that will solve the problem I shall be extremely grateful to you. One of the films which was presented here this week has not yet been included in our lecture course but will be during the coming year, and we are going to make a small fee charge for that. It cost us nearly $1,000 to get it; I mean "The Lineman," prepared by our Accident Prevention Committee, and I am proposing to make a couple of extra copies of it so that I can have it going at two or three places at once like a Gilbert-Sullivan opera.

There are one or two other features of the work to which I would like to refer. During the past five years we have gathered to-

gether in our office in New York what I believe to be as complete a collection as exists on this continent of the literature of the Public Service Commission, dating back to our first compilation of the laws of Wisconsin, Massachusetts and New York. Mr. Blood started that movement, and established a Public Policy Committee. We have found that it is a good thing, right thing, proper thing to work with the Commissions. We have also found that the Commissions, taking them all in all, are composed like ourselves of reasonable, decent, honest men, anxious to do the right thing, but in a great many cases they are horribly unexperienced and misinformed as to public utility conditions. I found a great opportunity to do a great deal of educational work with them and I am very glad indeed to say that wherever the opportunity has presented itself and our services have been asked for there has been most immediate and cordial response.

And there is another point in this respect which Mr. Henderschott did not touch upon, except allusively. We are up against what I may perhaps call one further question in the United States. I am not sufficiently informed as to the political history and development of Canada to know whether the "wave" has invaded you, but in a great many of the Western States, particularly on the Pacific Coast, our cities have gone in for local city commissions, wiping out the old form of political administration by mayor and aldermen, and in almost every case such a commission has had entrusted to it with full power, control over the public utilities. It is radical and revolutionary and dangerous to the utmost limit, because you can see at once that if every city in the United States or in Canada had its own commission, with its own experts, and each one insisting on his own standard of apparatus, of voltages and amperages and all kinds of conditions of that sort, regulation of meters within this percentage or that, why there would be utter chaos not only for the operators of the apparatus but for the manufacturers who could no longer standardize their output. Looked at from that standard alone, so long as we stay with and stand by public service commissions covering a whole State we are certainly on an infinitely more legitimate basis than if we were subjected to the chaos which the other conditions imply. I have no doubt my friend Mr. Kerr can enlarge on this much more ably than I have done. We have been able to do through and with commissions already a lot of good work. In one State, for example, the commission was going to put into effect some very radical rules as to pole lines and voltages. I wrote the commission and called attention to the fact that our Overhead Line Committee had had already specifications along that line and that their report would be out in a short time—and would it not be well to hold up. They did hold up and they waited and they accepted our standards. I have recently been taking up with the commissions the question of the Annual Return form and I presented at our Philadelphia Con-

vention the Annual Report form required by the public service commissions in the United States dealing with Central Station industry. When I got them together it was the first collection ever made of that kind and we were simply amazed to find that those reports ranged in size from one sheet to one hundred. I have brought that to the attention of the commissioners themselves and I think it stands to reason and is obvious that dealing with any rational body of men they will naturally get together and we will have some standard form which will not be so utterly burdensome as is represented by an annual report of 100 pages.

I could go on along these lines and digress on the work of the N. E. L. A. until I could bore you already more than I have done. All I can add to what I have said is that we are very glad indeed to have on the standing committees—we have fifty or sixty of them—some of the best central station representatives in Canada, and all that we ask is your continuing co-operation, support and assistance in the work that we are trying to do to build up what I believe to be the best industry that exists in the world today. (Applause).

I should have stated that the N. E. L. A. was founded by a Nova Scotian, J. Frank Morrison, our senior past President.

The President: Before asking Mr. Maclachlan, Mr. Kerr and Mr. Blood to speak it would appear to me wise to have a resolution expressing an opinion of the members as to the action of the Executive, and then we might have any criticism or suggestion as to this action.

Mr. R. Hume: I have pleasure in moving the following resolution:

"That, whereas this meeting has heard with interest the arguments put forward in favor of a special educational campaign to be carried on by Class "A" members of the C. E. A., and whereas the benefits to be obtained by such a campaign are to be desired in the interests of all privately owned companies in Canada, it is hereby resolved that the programme as submitted be adopted, that subscriptions be forthwith called for and that the details and supervision of such campaign be left in the hands of the Managing Committee."

I do not know why I have been asked to move that Resolution as the company I represent at this Convention is probably the youngest Class A member. But, whatever the reason, the terms of the Resolution heartily commend themselves to me and I have therefore pleasure in submitting them for your acceptance.

I may perhaps be permitted to introduce a personal note and say that I represent in this country large English financial interests. My company controls some fifty traction and power undertakings in England and abroad, including Bombay, India, and Auckland, New Zealand. We have several large investments here in Canada which I am looking after and it is my particular business to report upon

new propositions offering profitable scope for the employment of capital.

During my four years' residence in Canada I have closely observed the trend of current legislation, especially in the Province of Ontario, and I must say that I fear a continuance of the policy adopted by the Hydro-electric Power Commission is bound to scare away prospective investors in public utility enterprises in that province.

I had no intention of making a speech and my remarks are purely extempore, but I do feel that still greater harm will result unless steps are speedily taken to curtail the activities of the Commission and to put a bar across its progress. I also note that out in the Western Provinces municipal ownership is running rampant with all its concomitant effects. I have consequently struck those provinces off the map as unsuitable fields for investments. I believed the Maritime Provinces afforded a safe haven for capital and supported that belief by recommending a large investment in an industrial company which controls the company I am privileged to represent here today. But even those provinces, conservative and mindful of vested interests as they have heretofore proved themselves to be, have clothed their Public Utilities Commissions with extraordinarily wide powers —powers which if not wisely and reasonably administered, will endanger the security of public utility investments there. Fortunately, so far the Commissions have taken no action of a prejudicial character. Whether their future actions will be equally harmless probably depends to some extent upon the public utility companies themselves and to a larger extent upon the personnel of the Commissions.

In the Province of Quebec, too, the Public Utilities Commission seems to be exercising its wide powers in a reasonable manner with a due sense of its responsibilities towards the general public, as well as the private investor.

Still, the fact remains that this country is becoming permeated with socialistic ideas and is gradually ceasing to offer sufficient inducements for the employment of private capital in power and traction enterprises.

Consequently, I feel that it is the bounden duty of every public utility corporation in this country to take common action under the aegis of an Association such as this is and to make strong representations to the Federal Government and to the Provincial Governments that a continuance of the present policy must inevitably restrict further extensions of their undertakings. A country like this obviously cannot develop unless new capital is poured into it, and anything that obstructs the inflow of capital becomes a matter not only of local but of national concern. If you scare the investor in public utilities you also tend to scare the investor in railways, in industries and in all the multitudinous lines of a nation's activity, and you eventually scare capital out of the country.

I think that if the facts are convincingly put before the different

Governments—which after all are composed of reasonable men—if the facts, I say, are so placed before them by a strong Association like ours, there is every probability that the Governments will see the error of their ways and the wisdom of enacting such legislation as will encourage rather than discourage the continued and continuous inflow of private capital for public utility purposes.

I would like to take up one moment longer of your time and to say that I know something of municipal operation, something of the causes of municipalization in England. Briefly those causes are these: Under the Tramways Act of 1870 the municipalities had the right to own and construct tramways or street railways within their area but had no right to run those lines municipally. They leased them to companies, and at the end of 21 years the leases reverted to the municipalities, who granted another lease for a similar or lesser period. In those days the lines were of course worked by animal or steam traction. In a large number of cases the lines failed to pay. The result was that many companies went into liquidation. The public service was discontinued and the municipalities had the lines on their hands. It then occurred to some of the municipalities that they ought to have authority under such circumstances to operate the lines municipally. They therefore applied to Parliament and obtained the necessary authority. In that way municipal operation of street railways became established in Great Britain. With the subsequent advent of electric traction and the activity of companies such as mine in buying up semi-derelict lines with a view to electrification, came the idea that municipalities should more largely own and operate their tramways, or if circumstances prevented that consummation, that the traction companies should be compelled to carry out extensive street widenings at their own expense, carry passengers at extremely low fares and pay heavy yearly sums for the upkeep of the paving between the tracks and eighteen inches on either side thereof, and what has been the result? Many of the municipally operated lines are run at a loss and would, I venture to think, be gladly turned over to companies were not the 'amour propre' of the municipalities at stake. As for the privately owned and operated lines, so many have been unremunerative that it is now practically impossible to raise capital for traction enterprises in England itself. The outstanding feature, however, is the apparent weakening of municipal antagonism to private enterprise and the feeling that a monopoly wisely administered and regulated is perhaps after all the most satisfactory way of meeting public requirements, thence I have not much fear of further enactments of a harmful nature in England and I do not think that the present talk about the nationalization of railways will amount to anything, as the sound judgment of the nation is opposed to the principle.

Canada now appears to be going through the same process, 15 to 20 years after English experience, and I am sure you would do well

to seize this psychological moment to endeavor to stop the pernicious doctrine of municipal and provincial ownership of public utilities which is being preached by so many self-seeking politicians.

Holding those views, sir, I repeat that I have great pleasure in moving the Resolution which I read at the outset of my remarks. (Loud applause).

The President: I might say in regard to the Northern Electric Light Company of Cobalt, we have a letter from Mr. Black, the manager, stating he is in hearty accord with the movement.

Mr. R. J. Smith: I have much pleasure in seconding.

The President: Before asking you to vote upon the Resolution I would be glad to invite further criticism or any suggestions for the improvement of the work suggested.

Mr. J. S. Gould: I am in sympathy with the Resolution and with the rates that are proposed, but it seems to me there is a matter that has been overlooked in some cases; my own, for instance. It is a small thing, and while I would agree to it, it might perhaps not be agreed to by another company in operation in the town in which I live, whose representative is not here although a member of the C. E. A. That is in the matter of annual levy on companies for the raising of the funds necessary to carry on the work; it is based on the population of the municipality. My town comes in the second class between 5,000 and 10,000 people and, strange as it may be to some of you, we have two companies in opposition in that market and have had for the last twenty years. Now, it seems to me if that is going to be carried out it is going to amount to double assessment on our people, collecting two levies from a town which is under 10,000 population. I was not at the Executive meeting; I could not attend on the day when this proposition was made or I would have raised this point. I have no objection to it but I am afraid my competitors would have.

The President: I might say that it seems but fair that we receive a joint subscription from that town, each company paying half, whereas in this case both companies are members of the Association. I think, if this motion is passed, that the Executive ought to be allowed a little latitude in settling small matters of this kind.

Mr. Chambers: I am the only member here, I think, from Nova Scotia with the exception of Mr. Hulme, who lives in Montreal, and I would not like to have a Resolution passed without saying one word in reference to the fees. There is no such thing as competition in electric light in Nova Scotia under the laws of Nova Scotia. The Public Utility Commission regulates the rate. They will not permit competition. I had, perhaps, I think more to do than any other man in Nova Scotia except a certain member of the Government in bringing that state of affairs to pass. In fact, when the Commission was named it was called the Chambers' Commission more than it was

called the Public Utilities Commission, but now it has very great powers and everything in the province in that line has been put under it. We are the only company with the exception of one small company that they have made rates for, and they have made rates for us about 25 per cent. below surrounding companies, taking coal freight into consideration. All I wish to say is this: That you people up in Ontario are up against it. We are not so badly up against it down there in Nova Scotia as we do not fear competition. The only thing we fear is that they won't allow us a fair return on the money invested. Consequently I think that any rating of the expenses whereby companies in Nova Scotia, who are not afraid of this Hydro-electric, would be required to pay into this institution the same as the companies who are afraid of it, would be unfair. While I do not say myself I would not pay—I would not like, in the name of the province, to vote for others to pay the rates suggested. Although we have had our own troubles down there, we have never had any assistance from anybody and I think they might not be willing to pay as much in proportion as they should pay up here.

The President: I might say, of course, it is the understanding that this subscription is purely a voluntary one. This Resolution is merely empowering the Executive to proceed along the lines stipulated. We cannot force any company to come in. The amount is small; it cannot be considered a burden. We ask that such subscription be continued for three years to give your Executive a chance to show what can be done.

Mr. Monro Grier: I understand there are certain other gentlemen from the United States to speak. Am I right in supposing there are others to address us?

The President: There are two more. One of our own Executive, Mr. Maclachlan, is to give us his experience and state what one of the committee, namely, the Street Lighting Committee of the N. E. L. A., is doing towards ascertaining the best means of street illumination. Our reason for asking Mr. Maclachlan to do this is to illustrate how on the other side of the line they are working for the advancement of the industry.

Mr. Grier: My practical suggestion is that we should hear from the others now.

The President: The idea of putting the Resolution was that we would know to a certain extent where we stand.

I would ask Mr. Maclachlan to read his paper.

The Vice-President takes the chair.

Mr. Maclachlan's Report on Street Lighting

The President and Managing Committee have asked me to bring to your notice in a short way some of the advantages that accrue to the Canadian Electrical Association, due to the privilege of the Canadian Electrical Association having a member

on each standing committee of the National Electric Light Association. To do this I will outline the work of the Street Lighting Committee of the National Electric Light Association.

The question of street lighting has been taken up by committees of the National Electric Light Association since 1894, but it has been only within the last few years that it has been possible to expend a great deal of time and money on investigating problems of street lighting, due to the fact that other, possibly more important problems, were being investigated and were taking up all the time available.

Within the last few years, valuable data has been collected, and the Street Lighting Committee has been trying to present to the National Electric Light Association information that would be of value to the engineers and managers of central stations in investigating their own street lighting problems. The committee of 1894 made a report and suggested that the arc lamp that consumed 450 watts should be rated as a 2000 candle power lamp. The committee of 1907 suggested that arc lamps on a spacing of from 200 to 600 feet should be rated at the intensity of direct illumination as measured 200 to 300 feet away from the lamp on a level street. The Committees of 1911 and 1912 spent most of their time in investigating and collecting statistics with regard to ornamental street lighting, advertising value of street lighting, etc. The 1913 Committee went into the question of certain clauses in street lighting contracts, and made certain suggestions with regard to the important clauses in these contracts, and also presented the decisions from certain Public Service Commissions.

Taking the above into consideration, the Committee that reported at the 1914 Convention in Philadelphia thought that the time was ripe to go into fuller investigations with regard to street lighting problems, as this question was becoming of a very important nature, due to the fact that traffic speeds were greater, and the congestion of traffic in large cities was becoming very serious, and also due to the fact that the public in general was becoming educated to a point where it demanded higher standards of illumination than were used in the past.

At the initial meeting of the 1914 Committee plans were prepared to carry on certain experimental work in street lighting, and four objects were set forth to obtain definite information upon.

1st: Physical side of street lighting.

2nd: Psychological side of street lighting.

3rd: The Economics of street lighting.

4th: The ideal street lighting contract.

First, taking up the physical side of street lighting. It was arranged to have two streets that converge dat an angle, equipped for about one-half a mile each with experimental systems of street lighting, one street to be equipped with small incandescent lamps mount-

ed near the curbs. It was also arranged to have large incandescent lamps placed at regular intervals, but on a longer spacing than the small incandescent lamps. The other street is to be arranged so that it can be equipped with any type of illuminant that is on the market at the present time, and so that the spacing, height, etc., can be varied throughout the experiments, the object of the physical experiments being first, to obtain as ideal an illumination on the first mentioned street as possible and then use it as a comparison for comparing the other street as the illuminants were changed and as height and spacing was effected. After the tests were made it was the intention to take photometric readings and photographs in both streets after each experiment, and also it was arranged that the distribution curve of the different lamps used should be taken by ordinary laboratory methods.

At the very outset of the Committee's work, it was recognized that illumination has another phase besides the physical one, viz: the psychological. It was recognized that illumination must be judged from the effect that it has upon persons that are subjected to it, and the Committee, after investigating the good work that was being done by applied psychologists in investigating the degree of fatigue and other mental processes in connection with telephone operators, motormen, etc., decided that it would be well to have the assistance of a psychologist in arranging a series of tests that were to be applied to observers in connection with the investigation. Professor Hugo Munsterberg, Professor of Psychology in Harvard University, was invited to confer with the Committee in this regard, and after meeting the Professor and having some of the phases of psychology with regard to illumination explained, the Committee felt that it had opened up a new side to illumination, and that any report that it should make, that neglected the psychology of the situation, would be entirely inadequate. Professor Munsterberg explained that investigation of illumination by psychologists was, practically speaking, an unknown field, and that he would have to consider the matter very seriously before suggesting tests, but he agreed to think the matter over, and make certain suggestions to the Committee. It was afterwards arranged that a young psychologist under the direction of Professor Munsterberg should have an active part in the carrying on of the tests, these tests to be applied to private citizens, policemen, chauffers, and illumination experts.

At this point of the Committee's investigation it was thought advisable to obtain the advice and help of other bodies, who were deeply interested in the question of street lighting, and the Joint Street Lighting Committee was formed to consist of the Street Lighting Committee of the National Electric Light Association, the Street Lighting Committee of the Association of Edison Illuminating Companies, and an advistory committee to be formed of illumination experts. At a general meeting of this committee it was recognized

that any report on the question of street lighting would be very incomplete unless the question of economics was recognized, and it was arranged that at the same time as the tests were being made a Sub-Committee would be formed to carry on the work of obtaining data with regard to costs of construction, costs of maintenance, repairs and overhead expenses in connection with the different types of street lighting that were being investigated.

After looking over the work that was before the Committee it was thought that the data obtained would be very useful to any central station. The central station would have results of the physical tests of the illuminants, the results of the psychological tests of the illuminants and the economics of the situation, but it was felt that to round the situation out and to make it complete, that some definite suggestions with regard to the clauses of a street lighting contract should be incorporated. Mr. Mortimer, the President of the North American Company, was approached on this subject, and as he had recently some considerable experience in drawing up street lighting contracts, he was asked to be the Chairman of a Sub-Committee that would draw up a standard form of contract. This Committee was then formed, and they have made very satisfactory progress in the work that they have in hand.

The preliminary report of the Joint Street Lighting Committee was presented before the 1914 Convention of the National Electric Light Association at Philadelphia. To guard against errors all the data obtained by the Committee is to be considered as confidential until released for publication, and the final report is not expected to be presented until the 1915 Convention.

The above will give in a short way an idea of the thoroughness with which the Committees of the N. E. L. A. go into any matter that they take up, and it is the privilege of the Canadian Electrical Association to appoint one member on each of the standing committees of the N. E. L. A. It was my privilege during the past year to represent you on the Street Lighting, and it is certainly a distinct advantage for any man to work on the Committee with such men as constitute the N. E. L. A. Committees. These men represent the most up-to-date forms of practice in central station work. They have almost unlimited funds at their disposal, which funds do not necessarily come out of the general revenue of the N. E. L. A.; in fact, the money that is being expended by the Joint Street Lighting Committee is subscribed by member companies, the Association of Edison Illuminating Companies and by manufacturers, and not one cent expended is taken out of the general revenue of the N. E. L. A., although the estimated costs of the experiments will be large.

The Canadian Electrical Association members will get the benefit of the work that is being done by the standing committees of the N. E. L. A. by receiving copies of their report, but to get the full benefit of this work it is necessary to have representatives on these

Committees, and any central station company that has one of their officials on a Committee of the N. E. L. A. will receive a direct benefit by the fact that their representative is gaining by direct contact with the leaders in the particular work that the Committee is taking up, and is in this way obtaining the most valuable information possible for himself and his company. To secure this benefit for the general Class "A" members of the Canadian Electrical Association it would, I think, be necessary to form a similar committee in Canada to carry on the work that is done by the N. E. L. A. and adapt it to Canadian practice. This could be done by having the representative of the N. E. L. A. Committee the Chairman or at least a member of the Canadian Electrical Association Committee, and by a small expenditure great benefit would accrue to the Class "A" members of the Canadian Electrical Association. The past year is the first time that the Canadian Electrical Association has had representatives on the N. E. L. A. Committees, and we may look forward to great benefit resulting from this practice.

Taking the fact into consideration that the member companies of the C. E. A. obtain the information contained in the reports and other literature of the N. E. L. A. for such a small sum, it is certainly the duty of these companies to see that such information is to be considered as confidential and private, and should not be given out to others who are not members of the C. E. A., and also it is the duty of the member companies to see that employees, when they leave their employ, do not retain membership in the C. E. A. If this is not done, we will find that information that we consider confidential and private is getting into hands that do not hold the same views as the C. E. A. and N. E. L. A.

In the above I have confined myself to a description of the work of the Street Lighting Committee, but I have been assured by the men who have had the pleasure of being members of the other Committees of the N. E. L. A. that the method of carrying on the work in the Street Lighting Committee is fairly representative of the methods which the other standing N. E. L. A. Committees adopt.

It is not very many years since the Central Station Companies realized that they were more than a private institution. They have come to realize that they have a large public duty to perform, and are in every sense of the word public service corporations. One of the best means of serving the public is by using in every sphere of central station work the very best information and data that can be obtained.

The standing committees of the N. E. L. A. are from year to year bringing out reports that might be considered as classics in regard to central station practice. I need not mention the reports of the Meter Committee, the reports of the Overhead Lines Committee and the reports of the Publication Committee of the Commercial Section, and after next year we hope that the Street Light-

ing Committee will have marked a milestone in the advance of illuminating engineering in connection with street lighting. The advantage to the company and to the officers of the company that are represented on these committees, as shown above, may well be realized, but the real benefit will eventually come to the public, who will receive better service than they have received in the past, and although I realize that the question of rates is a very important one, yet I think that when the public has had time to get over the hysteria that has been affecting them within the last few years, they will realize that service and continuity of service is the big question in the supply of electricity, and the company that gains the benefit of the consensus of opinion of the foremost men in the industry, and who has its officials in close touch with these men by being on the committees of the National Electric Light Association, will be able to give to the public better service in every branch of central station work, and will become a real public service corporation, having for its motto an adaptation of the motto of the Prince of Wales, "Ich dien," making it "We serve."

Vice-President: I am sure we have all been interested in this very comprehensive report, showing the work that is being done largely for our mutual benefit, this being the result of our affiliation with the N. E. L. A.

In the next order of business I would call on Mr. Kerr to speak on Public Service Economics.

Mr. Kerr: It is gratifying for me to be able to express my own appreciation and thanks of the organization which I represent for the hospitality of the C. E. A. which I am enjoying today. I have not come with a speech and I beg of the Convention to remember that the remarks I will make are not directed to the situation in Canada. This is the most prolonged visit which I have had the pleasure of paying to the Dominion of Canada and I feel humble in appearing before you because of my lack of specific knowledge of conditions in the Dominion. With your permission I will bring you in the few minutes in which I will speak a specific text and I will attempt to make a dual application of the text and draw a brief moral. The text I bring you is the following: "Ye Shall know the truth and the truth shall make you free." I shall attempt to apply the text to the man on the street who has been mentioned heretofore in the discussion this afternoon, and to the man in the office.

"Ye shall know the truth and the truth shall make you free." The man on the street in the States in the last few years has been making an earnest effort to do something for himself. The man on the street in the States in the last few years has been making a persistent attack on public service injustice. The man on the street in the States in the last few years has been attempting to accomplish a result, more or less ill-defined, a result based on visionary ideals in many cases, a result which frequently is so ill digested that it has

no concrete expression whatsoever. The man on the street in the States has had an idea in the last few years that he was making himself free. The man on the street in the States appears to have had the idea that he was in bondage to the public service companies. Bondage may be in fact and may be in idea. Our worthy President has had considerable to say in the last few weeks about a condition in the business world which he has described as psychological. Bondage may be psychological; it may be actual.

"Ye shall know the truth and the truth shall make you free." The man on the street in the States has not had the facts. The man on the street in the States has been building in his mind, and to a growing extent in public sentiment and in legislation, a structure which is not based on the facts. The man on the street in the States is reaching a condition which to him is freedom, but which, because of the lack of facts, is likely to prove more burdensome than the condition which he has today. Public ownership will not free him.

The sentiment in the States with regard to the public utility industries, I think, properly may be expressed somewhat in the following fashion. For some years the idea grew in the public mind that public service corporations were over-capitalized; that the businesses were organized on values which to a large extent were fictitious. Time has proved to a large part of the public that in considerable measure this belief was the result more of hysteria than of fact. For instance, we have seen the development in the States of the idea that coupled with physical values in public utilities is an element known as going-value, an element sometimes described as intangible but more properly described as tangible because it represents real outlay. We have established the fallacy to a large extent of the over capitalization idea in the States.

The so-called reform movement, however, is shifting to a position which may be described somewhat as follows: In a public service business, in a business which is devoted to providing a public need, there should be no element of private gain. That is a theory which is brought out forcibly in a series of hearings before the House of Representatives Committee on the District of Columbia at Washington, where a Bill was under discussion which authorized the District of Columbia to purchase and operate the street railways in Washington. The position was taken flat-footedly by advocates of the Bill that in a public service industry regardless of all other factors there should be no element of private gain.

"Ye shall know the truth and the truth shall make you free." What is the truth of that position? It is a popular appeal. I throw the question before you as I would throw the question before the man on the street, and I suggest to you, as I would suggest to our people in the United States, that the facts do not substantiate the principle that a public service business should not be a means for private gain. The man on the street does not appreciate what the electrical industry is.

The man on the street does not appreciate that the electrical industry is the growth of but a bare thirty years. The man on the street does not appreciate the fact that the electrical industry is scarcely out of its initial stage. The man on the street does not appreciate that developments are going forward in the electrical industry as important in their significance as any developments that have occurred in the past. Within a month's time I heard the statement made by an authority that the electric incandescent lamp was destined to undergo most radical improvements in the very near future. The man on the street does not understand these matters. The man on the street does not understand where the initiative, where the progressiveness in the industry has come from. The man on the street in the absence of this information is acting unwisely in many cases. But he is not to be blamed if those who possess the truth, the facts, the information, fail to place it at his disposal.

Briefly I apply my text to the man in the office. The man in the office in the past has been immersed in the technical problems of his business. He has failed to realize in many cases the dependency of the business on the public and on the goodwill of the public. The man in the office has failed in many instances to appreciate the relations which he bore to men in other offices. The industry as a whole is his unit. It is true of the electric industry; it is true of all public service industry. Their relations to the public are the same and their relations to the public must be solved on the basis of the same principles. The concern of each office man is the concern of the other. The best illustration I can give you of this is the arrangement which has grown up in the banking industry in the United States. Following the panic of 1907, in most of the large banking centres of the United States voluntary clearing house committees were organized with absolute, mandatory powers over members of the Clearing House Association. The inspectors of the Assocations were given full power to go into the records of member banks and to report back to the clearing house the precise conditions which were found. The clearing house committees had the power voluntary vested in them to compel action to rectify any improper condition. It was recognized that the weakness of one was the weakness of all; that the banking interests of the community were a unit, not an aggregate of independent units.

The electrical industry and its individual members, the public service industry at large and its individual members need a clearing house. They need their clearing house for information; they need it for meeting the just demands of the public; they need it to promote their internal welfare.

The N. E. L. A. is a clearing house for problems of internal management in the United States. The N. E. L. A. is a clearing house for problems on public relations in the United States. The best practices and achievements of the various companies are brought to-

gether. The weak spots in various companies are approached by the industry itself for the purpose of remedying the defective link and thereby strengthening the entire industry.

So much for the text. Moral! A short word but a word potent of meaning—Act! The time to act is now. If a condition demanding effort is appreciated it cannot be attacked too soon. We are doing it in the States. You are doing it here. The bond between us is a very close one. It is a practical bond. Your experience backs our experience; our experience backs your experience; it is a sympathetic bond. What results in your territory reflects on us in our territory. What results in our territory reflects on you in your territory. We are obliged to meet in New York State, in every state of the Union, a problem given rise to by the development of a state-owned hydro-electric system in one of your provinces. You, on the other hand, in a very short time will have to meet a problem given rise to by three cent electricity in Cleveland, Ohio. We have mutual interests. The line of wisdom for us is to stand together, to act together and to work together along common lines. The moral is, Act! If the situation is appreciated no time should be lost. Do it now!

The President: We are getting a mine of information as to the value of co-operation.

I have much pleasure in now asking Mr. Blood, of Boston, to throw a little light on another practical phase of this co-operation, namely, the value of co-operation on the question of insurance. Mr. Blood is the expert of the N. E. L. A. and has given a great deal of time and thought to economies that may be effected by educational methods and by insurance precautions and co-operation between companies to secure protection and low rates of fire insurance.

Value of Co-operation in Insurance

Mr. Blood: Mr. Chairman and gentlemen, I wish first to state my full appreciation of the courtesy of the officers in inviting me to be here today to say a word to you. I take this as a recognition of the N. E. L. A. and not as a personal compliment.

I want to congratulate you on the splendid atmosphere at this convention. The excellence of the papers, which I have read, and the discussions which I have heard show that you are all active and energetic, alive to your surroundings, thoroughly interested in your work. In speaking about my work in connection with the N. E. L. A. I regret extremely that it will be necessary to use the personal pronoun and you will please pardon me if I seem to be egotistic.

In 1907 Mr. Arthur Williams, of New York, then President of the N. E. L. A., asked me if I would serve as Insurance Expert of the Association. This title had no particular significance, but I presume he thought my experience in placing ten to fifteen million dollars of fire insurance a year, and having in a few years reduced the

premium rates over fifty per cent., was sufficient reason for applying the title, but, be that as it may, it is my official title.

Since 1907 the work of the Insurance Expert has been broadened and has touched many phases which were not originally contemplated. In 1907 and shortly prior to that time the electric lighting interests had been having considerable friction with the Underwriters in connection with the rules which were being promulgated in the National Electrical Code. One of my first duties was to get in close touch with the Underwriters and to look out for the electric lighting companies' interests in the formulation of new rules and in revising the old rules. During the first year that I had anything to do with this, there were nearly 1,000 changes suggested in those rules, and each year since then there have been several hundred proposed changes, and every one of these has to be carefully considered to see what effect it will have on the electric lighting industry. At the present moment it may interest you to know there is a very strong movement on foot to have a rule adopted which will require on all wiring installations the use of an inflexible conduit. If such a rule goes into effect it may entirely stop electrical construction and so prevent any growth in earnings. It would prevent the use of knob and tube work, which is safe and plenty good enough in the vast majority of cases.

During the first year that the office was established I assisted the New York Edison Company in the defence of several important suits where it was alleged that certain buildings had been set on fire by the Electric Company, and, without going into the details, I will say that a most satisfactory compromise of those suits, involving a great many hundreds of thousands of dollars, was finally accomplished.

In my work with the Underwriters, from the beginning, they recognized the N. E. L. A. and accepted me as the official representative of the Association and forthwith put me on a committee through which the entire Code was revised and a great many objectionable rules, ambiguous phrases, and unnecessary fine print notes were eliminated. At about the same time it came to my attention that some of the branch organizations connected with the National Underwriters' Association were in the habit of getting out independent or supplemental rules. I had the pleasure of getting the National Board of Underwriters to pass a resolution prohibiting the getting out of supplemental rules by these branch associations, so that now we have in the United States, and I think in this country, the National Electrical Code as the single standard.

I have been very active in following lawsuits, on behalf of the Association, in reference to insurance matters. A very serious case arose in Denver, where an Electric Company was sued for something like $50,000 on the allegation that it set a church on fire through negligence in maintaining its wires. The church people thought they

did not get enough money out of the insurance company and so joined the insurance company in suing the electric light company. The total damage claimed was about $90,000, as I remember it. We proved conclusively that the electric light company did not set the church on fire.

The relations of our Association with the National Electrical Contractors have received some attention at my hands, so that a friendly feeling exists throughout the States between the National Electrical Contractors' Association and the N. E. L. A.

In a small city in Vermont, an order was issued by the State Commission requiring the company to put its wires underground. This would have involved an expenditure of $50,000 and it was impossible to raise so much money, as the company was practically bankrupt. By my appearance before the Commission I was able to show the unreasonableness of such an order and as a result the company was allowed to operate, without making any underground construction, by simply clearing up and making safe its overhead lines and poles.

At the present time there is a suit on in Hobart, Oklahoma, where a small company having a total capitalization of $135,000, including all its different classes of securities, is being sued for $90,000 on the allegation that it set fire to a department store. We have held the insurance companies off on that for about three years and it is possible that the suit may never come to trial. In any case, however, I feel sure, with a reasonable jury, we can convince them that the electric lighting company was not to blame.

The importance of following such cases and keeping adverse decisions off the records you can all appreciate, and it has been my work and my privilege to follow them pretty carefully.

In the States, competition from gasoline lighting has been quite severe in certain localities and we have waged war on the unsafe forms of gasoline lighting, of which there were many, with the result that gasoline illumination in the States today is practically a thing of the past.

Several years ago I gathered some interesting figures, which showed that in the United States the annual premiums paid by the electric lighting companies for fire insurance amounted to about $3,305,000, and that the maximum year of which I could get a record showed that the losses were $619,000. Allowing a reasonable amount for operating expenses, it was evident that the lighting companies were paying fully twice as much in their premiums as they should. We made an active campaign on this theory and as a result secured in some cases a reduction in premiums exceeding 50 per cent. and in many other cases a smaller reduction. I have no way of knowing exactly what the aggregate was, but an insurance man with whom I

am very friendly said that it probably represented an annual saving to the lighting companies of over $300,000.

I appeared for a local company in one of the suburbs of Providence, where the city had ordered the lighting company to place its wires underground or, rather, to show why they should not put their wires underground, and we very effectively showed why they should not. The company's rate at the time was 14¼c per kilowatt hour. To comply with the ordinance of the city and to have just broken even on the added investment the company would have been obliged to have raised its rate to 43 cents per kilowatt hour. The city officials saw the folly of such a drastic action and placed the resolution on the table, where it still remains.

I have followed the laws proposed by the different state legislatures in regard to wiring installation. In Virginia a law was proposed—not passed, fortunately—which contemplated placing the responsibility on the lighting companies for the condition of all wires on the customer's premises. That was fought and I am glad to say at the present time it is slumbering.

I had the pleasure of coming up and appearing in Quebec for your Montreal Company a year or two ago on a proposed underground order and I gave them some data which I hope was useful.

I wish to emphasize particularly, however, the work which is going on continuously on the National Electric Code with the National Fire Protection Association which now has charge of the National Electrical Code. The tendency of all inspectors is to increase the requirements of the Code rules. That means increase in cost of wiring installations. That brings about a decreasing number of installations. It affects the companies' interests vitally, for it tends to decrease its rate of growth. I have opposed at every turn every move which is made which tends to increase the cost of inside wiring, at the same time being always mindful that "safety first" is the great desideratum.

We are busy now and I hope something practicable, something tangible will come within the next year or so of a movement to suggest types of construction which will materially reduce construction expense, not merely keep the cost of wiring where it is, but materially reduce it. That is something in the future, but it is feasible, I believe.

I have frequently given advice and made suggestions as to insurance policies and the riders which are on all policies. One of my particular hobbies has been grounding secondaries. I have read over with a great deal of pleasure the excellent paper of Mr. Hood on grounding secondaries presented at this convention. No better paper, on this subject, than this has appeared at any convention, nor is any to be found in the proceedings of the N. E. L. A. In this connection I might state one or two things which may interest you, to show the way the grounding of secondaries is increasing throughout

the United States. The Public Service Commission or the Board of Public Utilities Commission, as it is called in the State of New Jersey, in a recent case made this statement: "It has clearly developed as a result of this hearing and enquiry that the grounding of transformer secondaries is necessary for the proper and adequate protection of life and property and necessary, therefore, for the rendition of due, proper and adequate service." The order has been so entered and it is now mandatory throughout the State of New Jersey to ground secondaries. I have in my hand a letter from the Commissioner of Wires of the City of Boston, in which he says they have been grounding secondaries for ten years, and he considers it absolutely imperative in the interests of safety to life and that such grounding has introduced no hazard and has caused no trouble in connection with the pipes to which they have been attached.

I made a canvas this year of a number of cities in the country as to grounding secondaries, and I found that out of a total of 575 answers 325 companies stated that they were grounding secondaries. This is really a matter of great importance and I am glad to see that grounding is so thoroughly endorsed in Mr. Hood's paper. I recommend, when you go home, that you gentlemen take steps to see that the grounding of secondaries is carried out in your own territory, and at once.

I have had to be personal in my remarks, because this work is the work of an individual. It is done, however, in co-operation with the National Electric Light Association and its officers. Secretary Martin frequently refers correspondence to me which I am glad to answer. Under the present arrangement my services are at the disposal of all members of the N. E. L. A. and I should like to offer, and I think I am perfectly justified in doing so, the same to the Class A members of the C. E. A., and if I can be of any assistance to them I shall be only too glad to help when I can.

Gentlemen, I thank you for your attention.

The President: I think it is quite in order now to submit the main resolution unless there may be further criticism or suggestion.

Mr. Ahearn: I did not expect to speak here. However, I would like to tell the meeting that I take it as a personal compliment that Mr. Street has been re-elected to the Presidency of this Association, because, sir, he has been associated with myself and my interests for a great many years and I know from my own experience that you could not have selected a better man.

I do not know that I can add much to the discussion that has been held here today about the troubles we are in, but they are certainly very real; I know that to be a fact. The conditions in Ontario in particular are very unfair and trying, and as far as your proposition goes about correcting the feeling that seems to prevail against electric service companies I think it is a very desirable one and you could not get at it too quickly. About the cost, I do not know how

you arrive at your plan of assessment; $50 being the minimum and going up in proportion to population. How do you know that it is going to cover the expense? I think you should name a minimum contribution and then call upon companies who are in a position to pay to aid in proportion to their ability to pay. As far as the Ottawa Electric Company is concerned I would not confine myself to the amount set out and I would be willing to give twice as much if it is found necessary. I think each company should give in proportion to its net income. There may be some companies who cannot, and other companies whose profits are such that they could without strain give more. Instead of being based on population I think it should be based on ability to pay. In the case of Ottawa Mr. Street has just asked me if we would double our contribution if necessary. I say yes, and if necessary, treble it. Give enough to effectively fight the enemy; that is the idea (Applause). If you cannot do it with $5 make it $10. I am satisfied from my experience of Mr. Street and Mr. Dion, one of the past-presidents, that anything they undertake they will go along with in a lively and vigorous manner. There will be no let up, and I am satisfied when Mr. Street says that he hopes to largely increase the number of the membership in Class A that he will do it and that from today you will have a much larger membership. I have had a very long experience in electric lighting. I suppose I am one of the earliest pioneers in Canada, having commenced about 1880 and have been at it ever since, and am familiar with the difficulties with municipalities, municipal councils and legislative bodies and the like. I am not so hopeful, as many of you appear to be, that you are going to emerge so soon with victory. I tell you it is a big problem, when you come to get an annual change of members in city councils and changing legislators and all that. After you get a man educated to his work you have to start on a new fellow; the situation abounds with difficulties. We may succeed in doing something, but it is going to be a big work. My own experience, in Ottawa in particular, is that our average alderman was not fit for the position, but I have come to the conclusion that he fairly represents the average intelligence of the community and that is about all there is to it. I think that applies everywhere, and the sooner we get together the better, and whether it costs $50 or $100 or $5,000 we have got to keep together and put our case thoroughly before the people and let them decide. If they say we are wrong and want public ownership, the honest way is to buy us out. When the gentleman who has just spoken says his British principals have instructed him not to invest in Ontario, that is an awfully hard blow for Ontario, and I should like that his statement should be heralded all over Ontario.

Mr. G. R. Hulme: My remarks were made confidentially.

Mr. Ahearn: I think that is what ought to be told to these people. There has been no respect in Ontario for our vested rights, none

whatever. It is simply because we have been able to fight them successfully in our own district that we exist today. I do not know how it is we have continued paying good dividends in face of the way we have been reducing rates, but we have been doing it nevertheless. I do not know how long it is going to go on. I hope it will go on indefinitely. I can only repeat so far as Ottawa is concerned that any assessment that Mr. Street recommends will be cheerfully given. (Applause).

The President: I might say with regard to the assessment, possibly I am an optimist, but I believe that every one of the Managing Committee is an optimist and our Secretary, with the assurance of success stamped across his face, feels that with our proposed assessment and by getting in practically every company in Canada, we will have funds sufficient. We do not want to make the tax burdensome upon the smaller company and we feel and have always felt, backed by what the large companies have done, that if we get beyond our depth the larger companies as in the past would jump in and save us. That is why we base the assessment upon population, feeling that it is a trifling matter for companies in small towns to give $25 or $50 a year, for three years. If at the end of three years we have not proved that this Association is a factor of usefulness throughout Canada, if we have not proved ourselves to be a power for good from the Atlantic to the Pacific, then I think it is time for us all to throw up our hands.

Mr. Ahearn: I think that we should look upon this tax more like a war tax. Governments of countries have to levy upon the people in times of stress; and this certainly is our time of stress, and if the amount you have named here is not sufficient we should not have to wait a whole twelve months to find it out. I think you should have authority now while this Convention is in session, that if this assessment is not found sufficient to carry out the work properly you should have power to make a further levy in accordance with the plan described.

Mr. D. H. McDougall: I think Mr. Ahearn's idea a splendid one but I also think we must not lose sight of the fact that every small station should, if possible, be made a contributor to this fund. The wider spread the interest, the more favorable public opinion we are going to create, because if a company in a very small town pays up $50 they are going to talk about it.

As to the unfairness of the fight, I would just like to cite an instance that came to my attention last week. The Toronto and Niagara Power Company, with which I am connected, had a franchise from the Dominion of Canada, allowing it to build lines for the transmission of power and distribution. Recently a village applied to us for service and we drew up a franchise which we were going to ask them to submit to their voters and put through in the regular way, in spite of the fact that our rights allow us to go into any place in Ontario or Canada without such consent. Not wishing to

be arbitrary we submitted a Bylaw in the usual way of an Ontario Company. This franchise was submitted to our solicitors. A short time ago we came in conflict with a municipality in building a transmission line and relied on our rights under our Charter. An injunction was applied for by the municipality to restrain us going through the town. But relying on our rights we were successful not only in the Canadian courts, but the Privy Council in England, in sustaining the right given us by the Dominion Parliament, declared that our company was a pioneer company and consequently it was quite evident that the Legislature had contemplated overruling municipal rights so as not to allow one municipality to jeopardize a pioneer enterprise in developing Niagara power and transmitting it for the benefit of other communities. Now, as I say, we submitted this new franchise to our solicitors for advice. The solicitor sent for me last week and he said: "A most peculiar thing, I have just found an Act passed last year that nobody heard of; has got about three clauses in it, and I am afraid you cannot get a franchise in the municipality." He showed me the Act which said that any company declared to be for the general advantage of Canada could not obtain a franchise from a town or municipality in Ontario without the consent of the Governor-in-Council. In other words, invalidating our entire rights in Ontario with the local authorities in spite of the Privy Council pronouncement. No notice whatever was given to the company or no publicity given to the act; it went through. Our own lawyer, who is a very up-to-date man, keeping track of legislation, etc., had no knowledge of it until he came to search the Statutes.

Mr. Ahearn: In Ottawa the Ottawa Electric Company will build a line from A. to B.; the municipality with its hydro-electric system had the right to place its wires on the poles of the Ottawa Electric Company. Of course this was done nearly twenty years ago and it was done with the idea at any time they wanted to light the streets of Ottawa they would have the right to put their wires for street lighting purposes on the poles of the Ottawa company. Well now, we build a line from A to B and B to C, along the different districts, new developments of the city, along comes the city and puts its wires up on the poles and bids for the business we open up in that district. They do it by paying a dollar a year tax for those poles. Did you ever hear the like of that? We are afraid as a matter of fact to develop in certain directions until we have all the neighborhood signed up on long term contracts before we start extending any lines, because along comes the city and strings its wires on poles they do not have to erect and takes the business away from the company which placed the line and owns it.

The President: I would like to hear a few remarks from Mr. Black.

Mr. Black: We have very little to do with the public, fortunately. We distribute our power largely to power users and to municipalities.

We have a good deal to do with the Hydro Commission, and our experience has been no more satisfactory than that of Mr. McDougall and Mr. Ahearn. This is the first opportunity that I have had of being present at one of these meetings and I must say that I think you are going about the matter in the right way. Public sentiment is something that has to be cultivated and on the whole the public are very fair in their conclusions. Such treatment has been meted out to the concerns who have been pioneers in the business in Ontario in times when there has been no money in it at all, by the present Hydro Commission of Ontario which seems so adverse to a fair and square deal, that I think if the matter is kept at and handled properly there is some chance of getting it put into a different shape than it is in at the present time. It would seem that if anything interferes with the Hydro carrying out any of its schemes, it simply goes to the Legislature and has a law put through to suit, and it does not matter who suffers or what the consequences are.

The address made by the first speaker this afternoon appealed very much to me, viz: the cultivation of friendly relations with the customers. So frequently I have heard people speaking about complaints they have made to Telephone, Electric Light Companies, etc. It very often happens, just as this gentleman says—a junior in the office answers the telephone and he does not know what he is talking about, and is not very much concerned either, and often an unsatisfactory answer is given. It is not taken as coming from the boy, but from the company, and that sort of thing will very often turn a customer over to an opposition company. The campaign that this company is carrying on, viz: educating their staffs in civility, I think is one that might very well be followed by the Canadian companies.

Mr. A. Monro Grier: Mr. President and gentlemen, I feel exceedingly diffident in saying anything this afternoon. As a good many of you know, perhaps, I have always two lines which I use alternatively of defence. If it is suggested at any time that I know anything about electrical energy I remind the man suggesting that I am a lawyer. If it is suggested I know some law I remind my friends that I am engaged in the production of electric energy; in any alternative I think I am equally ignorant. This afternoon I feel exceedingly diffident. If I put it figuratively, that I am much in the position of an ordinary layman coming across a post with the words: "60,000 volts. Dangerous; Keep away;" But I am emboldened to say a word or two by reason of the delightful atmosphere. I am not now speaking of the temperature which evidently has existed throughout this Convention. But first of all I should like to say a word or two in regard to the concrete suggestion of the resolution before the house now. In the first place I am not in the position which, more fortunately than I, Mr. Ahearn and others are in, of making an announcement with reference to their several companies. My position in the company which I happen to be connected with, although I per-

haps have a high enough sounding title, is not such as to direct what we will or will not do in regard to such a suggestion as this. On the other hand I can frankly say and speaking individually—and I think also in this I am speaking for the company—that I am heartily in sympathy with the motives which are behind the proposed resolution. Nothing could be better. Nothing could be more sound, nothing could be more desirable, since the effort in hand is really to tell the truth and to tell it so forcibly that those listening shall perforce and despite their objection to the hearing of truth, be obliged to hear it. I could not help thinking as I listened to some of the utterances this afternoon that, after all, we connected with electrical matters are old-fashioned. We have some sort of notion, I think, that there is some positive commandment put in negative form: we shall not steal. We have some sort of old fashioned idea there is also a commandment, Thou shalt not bear false witness against thy neighbor. Well, judging from things which I have listened to this afternoon and I am afraid judging also from things which have come before my observation, these things which should be in that negative form are changed so that with the sweep of the pen, as it were, a mere delete in the margin, the not is struck out and there is a positive injunction apparently for those who fight against us and those who serve under them: You shall steal. You shall bear false witness against thy neighbor. (Applause).

As I was standing by the shore of the Niagara River the other day I reflected with a good deal of sadness when I contemplated the millions of dollars which had been spent in several enterprises, but two of them competitors, rivals of the one with which I am connected; when I reflected not alone upon the millions spent, or the splendid energies, whether of body or heart or mind, and then contemplated that for no one connected with any of those enterprises, no matter how much he might have served his country in so devoting himself to their development, was there any honor but the honor was alone for those who fought against the enterprises which redounded to the credit and splendor of the country. (Applause).

Now, sir, with regard to these suggestions in the prefatory matter there was some allusion made to the desirability of having audits of commissions or other bodies which are by way of being public in their character. I heartily agree in the opinion that there should be a thorough audit of these enterprises and I think it will be found that however careful they may have been in the expenditure of moneys they have come far short of the care and of the zeal shown by the directors and officers of the privately owned corporations.

Then there are these suggestions as to what may be done. One is, that there might be mention in the press, insertion in the press of articles devoted to the interests of the privately owned companies. That strikes me as being an excellent thing. Secondly, that various

statistics should be acquired for the benefit of Class A members. That I heartily agree in. There was a suggestion that public service commissions should, if possible, be formed. That also seems to me to be sound. But in that connection it appeared to me that perhaps the wiser course would be to have the commission appointed in some other place than Ontario, if such a province can be found, and that having established one with a satisfactory constitution elsewhere we might then hold it up to the Dominion and the Province of Ontario and seek to have one formed there also.

I have left to the end one thing that is perhaps the most important because upon that I want to say one word. I do not want it to be taken as a departure from the spirit or from the expressed utterance of anyone who has spoken, but I do wish to say a word or two on the point of watching legislation which, I suppose, involves the idea of seeing governments and what not. My feeling about that is this: That largely that work must of necessity be done by the particular companies who are interested in particular legislation from time to time. But whilst I say that I, of course, quite admit the force and usefulness of having the combined body, a fine force, a splendid volume, a consensus of opinion, as giving strength to any expressed view which would not exist in the case of individual effort. Now, in regard to the assessment and what not, I do not find myself in a position of speaking to it, for the simple matter I am not yet in a position to announce the attitude of my company with regard to the matter practically. All I can say is, that I trust I shall be a faithful transmitter to the company of what I have listened to this afternoon. And if I am faithful in that—and now I am coming to the few general observations which I hope to make before I sit down—I trust also I shall be able faithfully to transmit some sort of notion of the fine spirit which I found prevailing in this last session of this afternoon. As one who has turned up so late, I hope it will not be unbecoming to express my appreciation of what must have been the splendid work of the Montreal men in arranging it. Then I wish to express my appreciation of the visitors from the United States. And it had occurred to me this afternoon as being a very charming and delightful point of contemplation that we have in this room almost every variety of English-speaking men that is engaged in electric work. We have Canadian-born still living in Canada; we have Englishman born living in the United States, and we have as well the Englishman born living in Canada, and yet the same spirit actuates all. And we have besides this the man born in the United States and still living and working there. And for my own part I feel now, as I always feel, that if you can get in conjunction those two fine sections of the English-speaking people anything is possible. There is nothing really which one cannot do if only one has the courage and we unite enough. I could not help thinking—though the words are not absolutely appropriate in a sense, yet the spirit of it will perhaps

fire us still more if I recall to you, perhaps not quite exactly, these words:

"Strike till the last dread foe expires!
Strike for your altars and your fires!
Strike for the gravestones of your sires;
God and your father!"

That is the sort of spirit which animates us all.

I congratulate not alone you but the Association itself upon your re-election to office. I congratulate the Association as well upon still having its admirable Secretary with his knowledge not only of manners and of men but language as well. You are happy to have such an official to serve you. Just one utterance only I give you at the end: Be united. Remember that we are one. Bear in mind that magnificent line of the poet: "Their veins are millions, their heart is one." (Applause).

The President: Before the motion I would like to hear a word from Mr. Mallison of the Montreal Public Service Commission.

Mr. Mallison: I hardly expected to be called upon to say anything this afternoon and I find it a very difficult matter indeed to make any expression. I did not have the pleasure of being present at the beginning of the session and I really am not familiar with the principal discussion that has gone on this afternoon. As the representative of what I might term the baby company of the industry in Montreal, I am sure I feel very much honored in saying a few words and I can only draw my conclusions with regard to the matter under discussion from gentlemen who have preceded me. I think the general theme of the afternoon has been the question of protection against what I might call an anarchistic or socialistic wave that is passing over Canada, from which we do not suffer very much in Quebec, thank goodness, because we seem to have rational people and rational legislatures here. But I can only draw my conclusions from gentlemen who have preceded me, that we are bound together pretty much by a bond of protection of our mutual interests, and I think while we do not suffer here in Quebec it is our duty to a very great extent to join together with those companies in those provinces which do suffer from this and support them as much as possible in fighting what may some day or another become a common foe. It is very fortunate for us that we have strong companies in the Province of Quebec and closely adjoining us in the Province of Ontario and I feel sure with united effort we will be able to combat successfully the attempt that has been made, particularly in Ontario, to deprive the companies of their rights in connection with the interests that they own and which I think ought to be conserved to them. It is fortunate for the Association also that we have the support and the assistance of our American cousins who, with their large centres of population, have gained experience which we have not had in Canada, and I think that

the Canadian Electrical Association ought to be congratulated in this regard.

I am sure that it is a great pleasure for me to have the honor of saying a few words and I hope that you will pardon me, that as a member of the Entertainment Committee I have found it very difficult to follow the papers, and that you will excuse me for my lack of knowledge of the question under discussion to-day. At the same time I am very pleased indeed to have the honor of representing our new company. This is our first appearance here. It is our inaugural subscription, but I hope as the time goes on that we will be able both by force of representation and by our financial success as the project develops, to be of some considerable assistance to the Electrical Association.

The President: Before submitting the motion it might not be out of order to tell Mr. Ahearn that in regard to giving publicity to Mr. Hulme's expressions respecting the investment of capital in Ontario, the intention of the Association was to do that from the other end, to have expressions of that kind appearing in the English Press and have them copied from the English Press into the Canadian papers.

We will be glad to have criticisms from anybody else present. If none I will ask you to vote upon the main motion as submitted by Mr. Hulme. I do not think it is necessary to read it again.

Carried unanimously.

Mr. Ahearn: I have much pleasure, indeed, gentlemen, in moving:

"That the hearty thanks of this meeting be extended to those gentlemen who have given us the benefit of their experience and advice, and that this Association expresses its sincere pleasure at having with us representatives of our sister society, the N. E. L. A."

Before putting the motion I would like to bear testimony to the great courtesies that I have received from my friend Mr. Martin, the honored Secretary of the N. E. L. A. On many occasions I have gone abroad to various countries, bearing letters of introduction from Mr. Martin, which I have found invaluable in all parts of the world. I mention this to show his world-wide acquaintance. Mr. Martin knows everybody everywhere, and is as popular abroad as he is in New York. As a Canadian I feel highly honored that he is present here to-day, and has done the Canadian Association such an honor in giving its proceedings such close attention, and the wide information he possesses.

Mr. Black: I have very much pleasure indeed in seconding this motion. I think it is very nice, indeed, for these gentlemen to come such a distance and bring before us their ideas. I think the connection between the two Associations must do a very great deal of good and probably we shall derive great advantage from it. I have very much pleasure in seconding that motion.

Carried unanimously.

Mr. Henderschott: In reply to your vote of thanks might I say

on behalf of the Public Policy Committee of the N. E. L. A. that you shall always find us at your service. (hear, hear and applause).

The President: I can only say that the Canadian Electrical Association appreciates your remarks, and we know that not only is it the policy of the Public Policy Committee but it is also the public policy of the N. E. L. A. to help anybody and everybody interested in the electrical industry.

I would ask those Class A members who are present to do a little missionary work when they leave here. There are a large number of companies in Canada and your word will go a long way towards bringing them into the fold. If there is nothing further I will now declare the meeting adjourned.